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Editorial Notes

Solid Smokeless Fuel

We have expressed the view before, and we repeat it here, that our Industry would be well advised to keep in touch much more closely with the developments taking place in the production of smokeless fuels for the open firegrate by low-temperature carbonization. We say this in the knowledge that the public demand for a satisfactory solid smokeless fuel is growing rapidly, and because we think that, as things stand at present, the Gas Industry is just a little hazy about the whole matter. We ought to be in a position to assess the merits of processes at present operating, and we ought to have clearer conceptions of their future possibilities. An examination of the whole situation would, we suggest, serve a useful purpose, for we cannot afford to neglect progress in any field of carbonization.

In to-day's "Journal" Mr. A. R. Griggs introduces a newcomer into the field of low-temperature carbonization—the process of the Coal Research Syndicate for the manufacture of solid smokeless fuel. It is of particular interest in that it treats in bulk non-caking or weakly-caking coals and thus is a development collateral to those processes utilizing the caking varieties. The argument put forward by Mr. Griggs is logical enough. It is simply that the growing demand for caking slacks must ultimately result in higher market prices for this class of coal, and consequently there is a definite place for a process along parallel lines which can utilize for the manufacture of solid smokeless fuel the type of raw coal it displaces. Naturally the claim of the Coal Research Syndicate is that it has a process which can treat, on a commercial profit-earning basis, the higher-priced non-caking coals as supplied to the house coal market.

Then Mr. Griggs suggests that there is no reason why the Gas Industry should not take up and develop the manufacture of free-burning solid smokeless fuel while continuing to expand the sales of high-temperature coke. The potential field is so enormous—he visualizes the 40,000,000 tons of raw coal at present consumed domestically—that there is room in plenty for both high-temperature and low-temperature cokes. Moreover, the production of high-temperature coke is necessarily related to the demand for gas. The basic consideration is, however, that so far low-temperature carbonization has not suggested itself as economically attractive to the Gas Industry. There is no question, for example, of the popularity of Metro-Coalite, yet so far, as Dr. Carpenter explained at the annual meeting of the South Metropolitan Gas Company, the process has been worked at a loss—a loss which, however, it is hoped to correct later on. The point we could emphasize is the growing public demand for a free-burning solid smokeless fuel.

A Growing Demand

At the same time, too, there is a growing demand for high-temperature coke properly prepared for the market. We referred to this matter in these columns a fortnight ago. We called attention to the increased revenue from coke which is such a bright feature of the past year's working of gas undertakings generally, and which, we suggested, provides the answer to any doubts as to the desirability of embarking on schemes to improve coke quality and efficiently to grade the smokeless solid fuel to satisfy the requirements of particular markets. In regard to the gratifying results of 1935 in this respect, we may lay claim to have played some part in their achievement by our insistence on the value of the coke market and the need for gas undertakings to equip themselves to cater for it. As an example of what we mean by this we may mention that only this week a correspondent, the engineer and manager of a large gas undertaking, wrote to tell us that, owing to the improvement in the coke he is now producing, the demand has become so great that, to keep faith with existing contracts and satisfy the growing domestic business, he has had to purchase a very large quantity of coke from other sources. And we may be pardoned for quoting the following from his letter: "The editorial notes that have recently appeared in the 'Gas Journal' have no doubt had a good deal of influence in improving the quality and also the sales of gas coke for domestic use."

Complete Gasification

In maintaining that good coke sales spell good gas sales, we do not for a moment forget that the Gas Industry is protected by statute in the supply of gas—that in the areas scheduled for supply no one else can come along and compete in gas supply. On the other hand, we appreciate that there is no such protection in regard to the supply of the other products which go hand in hand with the present practice of carbonization at gas-works. Anybody can compete with coke, for example, in a free market. Therefore, it may be argued with all justification that the *raison d'être* of the Gas Industry is to supply gas, and that it would be in a far more secure position if it could supply cheap gas without in any way being influenced by market fluctuations of by-products. Which, of

course, means complete gasification. As we have said, this is a sound argument, and as a corollary it follows that all developments should be watched, investigated, and encouraged which might make possible the production of gas at a very cheap rate by completely gasifying coal. It would be a splendid thing for the Gas Industry if in such a way it could make gas much more cheaply than by present methods—at rates which would, in fact, herald a transformed gas-using era. One process which appears of promise is at the moment being investigated by The Institution of Gas Engineers. It is the process which employs oxygen in the continuous gasification of coal under pressure, and it is stated that gas of a calorific value of 500 B.Th.U. can be made without difficulty and that the cost of oxygen made by a simplified Linde process is much lower than hitherto. That pressure systems have opened up new fields for exploration goes without saying, and we may yet find complete gasification of coal the most economical means of making gas.

This has yet to be proved, however, whereas in the meantime it is a proved fact that the better the coke market, the lower the price of gas, and that one way of extending gas sales is to make coke of good quality. And we see no reason why, if there is a public demand for more than one type of solid smokeless fuel, which we think there is, and the Gas Industry finds that it can make an adequate profit on its manufacture, the Industry should not set about production.

Moisture In Coal

We publish in our issue to-day a most interesting communication from the South Metropolitan Gas Company's Coal Laboratories at Newcastle-upon-Tyne concerning the moisture content of coal and its relation to other properties of the coal. The moisture of coal, as is well known, is customarily classified as that removed by air-drying, and that not removed by air-drying, or " inherent " as distinct from " free " moisture—in other words, avoidable and unavoidable moisture. At present, tests devised to give this differentiation are carried out under variable conditions of humidity and temperature and give figures of no obvious constancy or relation to other analytical data. In experiments conducted at the Company's coal laboratories, it was decided to ascertain what amounts of moisture were retained under certain controlled conditions arbitrarily chosen; and so far about 100 samples have been tested. It has been found that the amount of moisture retained by a coal under these or similar controlled conditions is, generally speaking, a function of its fixed carbon content, and for a large proportion of the coals tested it is possible, after drying under specified conditions, accurately to predict the moisture content.

It has been further discovered that this moisture content is also closely related to the swelling power of a coal; and if the swelling property is regarded as an index to the coking qualities of a coal, it follows that this moisture determination can also indicate the coking values of some coals. The conclusion is drawn that " the moisture content of a coal after drying under specified conditions depends fundamentally on its rank, and divergencies from the rule are to be attributed to variation in the proportion of coal constituents, which represent the metamorphosed products of different types of vegetable substances segregated in the earliest stages of the coal forming process." It is, as the communication suggests, highly desirable that some standard method of air-drying coals should be agreed upon as soon as possible. The figures which would then become available from a wide range of coal types would aid considerably in the elucidation of the problem of the constitution of coal.

Facing Competition

The Junior Gas Associations are fortunate in the support and encouragement they receive from the Seniors, though we should add at once that it would be very foolish if the Seniors withheld such support. In his Presidential Address to the Manchester District Association of Gas Engineers Mr. A. L. Holton asked for further official recognition of the Junior Associations, and expressed the view that it would be in the interests of the Industry if the link between the Joint Junior Gas Council and The Institution of Gas Engineers were considerably strengthened. This support of which we speak gives to the younger members of our Industry an added interest in their work; an example is provided by the Address which Mr. David Fulton, of Helensburgh, gave to the Western District of the Scottish Junior Gas Association, and which, be it noted, was open to discussion.

Mr. Fulton discusses several aspects of gas in competition, starting with the first line of defence—the lighting load. Retention of this load, which the electricians consider as being essentially their own, demands much effort and costs money. It entails systematic maintenance schemes, and it is not sufficient to overhaul and adjust fittings so that they may give the best service of which they are capable. There must be created, as Mr. Fulton emphasizes, a desire for newer fashions, for better gas lighting, for modern equipment; and easy purchase facilities should be arranged for ordinary and prepayment consumers alike. This was the plan adopted at Helensburgh to withstand electrical competition introduced in what is a comparatively well-to-do area in 1927. The success of the scheme is shown in Mr. Fulton's Address. Whereas in 1932 the number of burners and pendants fitted was 162, the corresponding number for 1935 was 823, a volume of business which necessitated the engagement of additional fitters.

The Right Attitude

The aggressive attitude of Mr. Fulton in face of competition is not, of course, confined to the lighting load, and the attitude is reflected in the working results of the Helensburgh Undertaking. It is interesting to compare a few figures relating to the years 1927 and 1935. In the former year the average consumption of the ordinary consumer was 57,344 cu.ft., and of the prepayment consumer 25,647 cu.ft. The corresponding figures for 1935 were 62,551 cu.ft. and 31,506 cu.ft. Again, since the commencement of electrical competition, the amount of gas sold for public lighting has increased from 5½ to 8 million cu.ft. per annum. This increase in the consumption per consumer is indication of the live sales organization of the Helensburgh Gas Department. It has been achieved, too, without the introduction of an optional two-part tariff, which Mr. Fulton strongly supports, but which does not at the moment find favour with his Town Council. We hope that a greater appreciation of the importance of being able to quote low commodity rates will result in a change in the Council's present attitude to what is one of the most vital questions of sales policy.

Among other matters dealt with by Mr. Fulton is the domestic water heating load, which remains to be developed and which will have a great bearing on that all-important consumption per consumer figure. And in regard to this load Mr. Fulton is not a supporter of low-consumption heaters of the thermal storage type. A great virtue of gas heating, he rightly points out, is that water can be heated quickly, while slow water heating favours electricity. Speed is undoubtedly a great selling point for gas; the best selling point of all, however, is

that there are types of appliance to meet every situation. Discussing this question in these columns only a few weeks ago we said that it is generally recognized that the instantaneous heater is an excellent type covering an extensive range of usage. Its merit lies in the fact that it affords an immediate supply of hot water and continues to give this supply as long as needed. Whether the demand be large or small, the instantaneous heater is capable of meeting it. This form of heater does, however, necessitate a flue, and, for bath purposes, the limit it imposes on the rate of flow of hot water is not fundamentally in its favour. Many consumers demand that a bath should be prepared with a full hot water flow, and this can only be obtained from some form of storage heater. There is also the question of the incidence of the water heating load to be considered, and in our view concentration on any one form of gas water heater is not the best policy. Many circumstances are best met by the instantaneous type; other conditions by the storage heater.

The Electrical Million

WITHOUT wishing it to be regarded in any spirit of alarm or panic, we invite the attention of the Gas Industry to the " million new consumers " campaign which is being waged by our electrical competitors. We suggest that perhaps its significance is not generally appreciated by the individual gas manager, whereas it is frequently by the individual that strong local neutralizing action can best be taken in cases of this kind. We have, therefore, given some thought to the details, from which we draw the conclusion that the new campaign must be regarded as something more than mere window dressing. It is based on a scheme which has been plotted along national lines. The drive to obtain a million new consumers is only the first step in a carefully-prepared plan of action. To begin with, an intelligent effort has been made to explore the limits of the working-class market for electricity. The long-range objective is the all-but-electrification of the seven million homes where the average income is £3 a week or less.

The first question to be asked is how much such families can afford to pay for electricity. Available statistics show that such households as a rule are prepared to spend up to 10% of income on light and heat. It may be assumed that each family in this class can spend from four to five shillings a week on light and heat. It is obvious, therefore, that complete household electrification is out of the question in such cases, and it is this consideration that leads the electricians to propose a compromise between electricity and coal. It is roughly calculated that the expenditure on coal should be about two shillings a week, leaving half-a-crown or more per week for electricity.

This sum must be made to cover not only the cost of current but also the fixed charges for assisted wiring, hire of cooker and wash copper (which can supply the bath), and standing charge. The electricity industry is determined not to allow the cost of wiring and apparatus to stand in the way of current consumption. To this end it has set itself with considerable ingenuity to devise methods of collecting fixed charges in ways which will commend themselves to the ordinary working-class family. Among the suggestions put forward in discussions are that standing charges should be collected with the rent; that " equated " flat rates calculated to include standing charges should be charged through an ordinary slot meter, with a rebate system as in the Gas Industry, and that two-part tariff meters should be installed with the idea of teaching consumers to buy service as well as current by putting coins in the slot. Immense importance is attached to the numbers and personal quality of the outdoor staff in dealing with this class of consumer. It is emphasized that close personal contact is the only way of making rapid sales progress, and it is often said that each outdoor salesman brings in, on an average, business worth seven times his wages. In addition, demonstrations are playing an increasing part in electrical sales promotion. In the case of vacuum cleaners, demonstration has been necessary to clinch sales, and it is felt that practical demonstrations, both to groups of consumers and to individuals, will in future be an essential factor in the sales of cookers, refrigerators, washing machines, and other domestic appliances. The central organizations of the electrical industry are prolific in suggestions for co-ordination of sales practices.

It may be said that as yet their plans are only in the paper stage. But the tendency to look for and adhere to a nationally-framed selling plan is gaining ground, and the Gas Industry must not disregard the danger-signals.

Aiming High

WHILE on the subject of our competitors, it is worth remarking that during the past few days speeches in connection with the electrical industry have provided more than one instance of laudable ambition of which it would be remiss on the part of the Gas Industry not to take careful note. For much of what the electrical industry can hope to do, the Gas Industry should be able to do as well, or better. In passing, it may be remarked that, when submitting the accounts for the past year to the annual general meeting, the Chairman of the City of London Electric Lighting Company was able to point to results which he invited the shareholders to agree with him fully justified " the spectacular concessions made to the customers in 1934."

Service to offices, of course, provides the City of London Electric Lighting Company with a vital part of their business, and every assistance is offered to customers in the planning and improvement of their lighting arrangements. In spite of this, however, it is realized that much still remains to be done in improving the illumination and ventilation of offices so as to render them more healthy for their occupants. It is the latter point that particularly attracted our attention, because the Chairman remarked upon the fact that in America the conditioning of air in buildings has become a common practice, and it is his opinion that the natural desire in this country for more healthy conditions will in due course make air-conditioning a necessity in every building where people congregate in large numbers for lengthy periods. The Chairman added that, in promoting the health of the community, electricity has played, and will play, a lead.

In the matter of air conditioning, it might be urged that electricity, in consequence of its inefficiency in stimulating ventilation when used for lighting or warming, is to some extent responsible for the state of affairs which it would be endeavouring to remedy. But purity, of course, need not be the only reason for desiring air conditioning; an equable temperature summer and winter may be the main consideration, and it is probable that the demand for domestic air conditioning will remain keenest in countries which experience extremes of heat and cold. This, no doubt, partly explains its more general use in America. Whatever the cause, however, it is a fact that a good deal was heard on the subject during the Institution tour in the United States less than three years ago. Round about that time, there had been finished the first complete installation in Philadelphia of all-the-year-round residential air-conditioning by gas, and a description of the installation which was given at the time in the " JOURNAL." It is well known that considerable progress has been made since then in the technique and application of the process.

Personal

Mr. Alan Hetherington Nicholson, a former pupil of Mr. W. W. Atley, Engineer and General Manager of the Stockton-on-Tees Corporation Gas Department, has been appointed Assistant Engineer and Manager to the Colne Gas Department. After completion of his training at the Stockton Gas-Works, Mr. Nicholson was employed for two years in the drawing office of Messrs. Ashmore, Benson, Pease & Co., of Stockton. He then received an appointment with the Darlington Gas Department as Technical Assistant. After a period of three years he moved to Bingley.

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Burnley Gas Committee has appointed Mr. H. Shackleton, Assistant Manager of Grantham Gas Department for the last five years, as second Assistant Engineer to their Undertaking.

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In connection with the establishment of a new position of Distribution Engineer by the North Shore Gas Company, of New South Wales, from a number of applicants who were considered, including several from England, the Board have selected Mr. T. W. Hughes, who has had sixteen years' experience with the Australian Gas Light Company of Sydney.

Forthcoming Engagements

March.

27.—Southern Association.—Annual General Meeting and Presidential Address of R. J. H. Clark.
30.—I.G.E.—Gasholder Committee, 2.30 p.m.
31.—I.G.E.—Research Executive Committee, 2.30 p.m.

April.

2.—Midland Junior Association.—Meeting. Paper by Mr. F. J. Bengough.
3.—B.C.G.A.—Annual Meeting of Gas Salesmen, Caxton Hall, S.W. 1.
3.—North British Association.—Spring Meeting at Glasgow.
4.—Manchester and District Junior Association.—Annual Dinner. Paper by Mr. J. A. Speers.
4.—Scottish Eastern Junior Association.—Meeting at Hawick.
6.—I.G.E.—Finance Committee, 1.45 p.m.; Membership Committee, 2.15 p.m.; General Purposes Committee, 3 p.m; Benevolent Fund Committee of Management, 4.30 p.m.
6.—B.G.F.—Exhibitions Committee Meeting, 28, Grosvenor Gardens, S.W. 1, 12 noon.
7.—N.G.C.—Central Executive Board Meeting, 2.30 p.m.
8.—B.C.G.A.—Annual Meeting of Members in Scotland; North British Station Hotel, Edinburgh, 2.15 p.m.; preceded by Meeting of Committee for Scotland, 11 a.m.
10.—I.G.E.—Council Meeting, 10 a.m.
18.—Yorkshire Junior Association.—Meeting.
18.—Western Junior Association.—Meeting at Plymouth. Presidential Address of Mr. J. H. Dyde.
18.—Wales and Monmouthshire Junior Association.—Annual General Meeting at Caldicot.
21.—I.G.E.—Gas Education Executive Committee, 11 a.m.; Gas Education Committee, 2.30 p.m.
23.—I.G.E.—Joint Lighting Committee, 2.30 p.m.
25.—Western Junior Association.—Meeting at Plymouth. Presidential Address of Mr. J. H. Dyde.

May.

1.—I.G.E.—Liquor Effluents and Ammonia Committee, 11.15 a.m.; Joint Research Committee, 2.30 p.m.
1.—London and Southern Junior Association.—Annual Business Meeting.
5.—I.G.E.—Research Executive Committee, 2.30 p.m.
6-7.—Eastern Counties Gas Managers' Association.—Spring Meeting at Lincoln.
7.—Midland Junior Association.—Annual General Meeting. Address by Mr. E. W. Smith.
9.—Scottish Eastern Junior Association.—Annual General Meeting.
13.—Yorkshire Junior Association.—Meeting at Leeds with Salesmen's Circle.
19.—I.G.E.—Gas Education Executive Committee, 2.30 p.m.
26-29.—I.G.E.—Annual General Meeting.

News in Brief

An Alteration of Calorific Value from 450 B.Th.U. to 470 B.Th.U. as and from July 1, 1936, is announced by the Woking District Gas Company.

To Authorize the Purchase of Land for gas-works purposes is the object of an application to the Board of Trade by the Newcastle-under-Lyme Corporation for a Special Order.

Application is to be Made by the Watford and St. Albans Gas Company to the Board of Trade for a Special Order to empower them to purchase land for gas-works purposes.

An Extension of Limits is one of the objects of a Special Order under the Gas Undertakings Acts, 1920 to 1934, for which the Bridgnorth Corporation intend to apply to the Board of Trade.

A Qualified Works Superintendent is required by the Rotherham Gas Department. The applicant must possess a thorough knowledge of mechanical engineering and gas-works practice, and be capable of carrying out all works routine tests. The commencing salary is £300 per annum.

A Black-Out Occurred at St. Peter-Port, Guernsey, on Saturday evening, March 21, from 7.50 to 8.40 p.m., when the electricity supply failed. Widespread confusion resulted in the town, but at the Guille-Allès Library two statuesque gas lamps were again commissioned and so averted casualties among those leaving the building.

For a Reduction of the Assessment upon the Gas-Works and mains in Congleton from £2,000 to £1,400 rateable value, the Macclesfield Assessment Committee has confirmed an arrangement made between Messrs. Ryde, Sons, & Brown, Surveyors, acting for the Borough of Congleton Gas Department, and Mr. Stanley Turner, Valuer to the Rating Authority.

Considerable Interest was displayed at the recent gas cookery demonstrations at Southport, 3,000 persons taking advantage of the splendid arrangements made by Mr. J. Herbert Clegg, Engineer and Manager, of the Southport Gas Department. An excellent display of modern gas appliances by Cannon Iron Foundries, Ltd., evoked the admiration of an appreciative public.

"**The Free State Electricity Board** are not going to dictate to us," declared the Chairman at Navan Urban Council when a letter was read from the Board, stating that a representative would call at an early date to discuss arrangements for the public lighting of the town. The meeting decided to ask both the Electricity Supply Board and the local Gas Company to send in quotations.

The New Issue of £49,000 4% debenture stock for which the Plymouth and Stonehouse Gas Light and Coke Company recently invited tenders was largely oversubscribed, prices ranging from £101 to £110. The additional capital is to be employed mainly to finance the extension of mains at Tamerton Foliot, St. Burdeaux, and other outlying districts and for the replacement of obsolete cookers.

Mr. S. B. Chandler, M.Inst.Gas E., Distribution Superintendent of the Tottenham and District Gas Company, on March 17 delivered an interesting Address on the "History of Gas" before the Wood Green Ratepayers' Association. Mr. Chandler dealt with the early years of the Industry leading up to modern lighting requirements, and during the course of his Address gave practical demonstrations of lighting efficiencies of luminous and incandescent burners and their domestic applications.

Gas Lighting in Ships a century ago was the subject of an article on March 23, 1836, in *The Times*, which said: "A steam vessel is fitting in the river which is to be lighted by gas, on a plan suggested by Lt. Engledue, R.N. Two retorts are placed in the fires under the boiler about two hours before dark, which will supply gas sufficient to burn the whole night, lighting the cabins, engine room, and masthead. This may be fitted at a trifling expense and without the slightest danger, the whole apparatus being on deck."—[From *Nature* for March 21.]

Five Lectures at High Schools were recently arranged by the Stoke-on-Trent Gas Department and given by Mr. Jennings, of the B.C.G.A. Nine hundred and sixty students and thirty teachers attended the various lectures, keen appreciation of the subject being shown on each occasion. Particular emphasis was laid on the damage to buildings and the danger to health from the smoke poured out from domestic chimneys. The assistance which the Gas Industry afforded in combatting the smoke nuisance was explained in a novel and interesting manner free from technicalities or advertisement.

Sir Francis Goodenough Honoured

Presentation of Portrait By Incorporated Sales Managers' Association

Our photograph, taken at the presentation, shows, on the left, Mr. G. Hall Neale (the Artist), and, on the right, the Rt. Hon. Sir Malcolm Robertson, G.C.M.G., K.B.E. (President of the Association), Mr. H. Pickup, and Mr. W. A. Cooke, B.Sc. (Chairman of the Association).

When all arrangements had been made for a Dining Meeting of the Incorporated Sales Managers' Association last Thursday, at which a presentation was to be made to Sir Francis Goodenough, great disappointment was caused by his inability to be present as the outcome of a chill contracted in Cardiff recently. The presentation was of Sir Francis' portrait in oils, by Mr. G. Hall Neale, in recognition of his services to the Association as Chairman and President, 1926 to 1934. In his greatly regretted absence the portrait was accepted on his behalf by Mr. H. Pickup, who had been Chairman during Sir Francis' Presidency.

The presentation was made on behalf of the Association by the President, the Rt. Hon. Sir Malcolm Robertson, G.C.M.G., K.B.E., who, speaking of Sir Francis' services, remarked: "His services to this particular Association have been great. He became a member in 1921, was Chairman from 1926 to 1929, and President from 1929 to 1934. His first service was to secure 59 of the leading men in the country to become Patrons. Any of you who have tried to do that will appreciate what the achievement means. He persuaded Lord Burnham to become our President. While he was Chairman the Duke of York attended in 1928 on an occasion at which many distinguished men, including Lord Eustace Percy, were present. In 1930 our most Gracious Majesty, then the Prince of Wales, attended and spoke at the Annual Dinner of the Association, and again on the occasion of the coming of age of the Association. The increase in membership which took place during his time is enormous. He became Chairman in 1926 and the membership was 557. In 1911 it was only 20! From 1926 until 1934 it grew from 557 to 1,608. At the present moment the figure is 1,800. Those figures are good, but they ought to be still greater.

"When I think of Sir Francis, of his imagination and energy, and his whole-hearted devotion to the trade and commerce of this country, I feel that when I took over the Presidency I was trying to step into boots a good deal too big for me. Sir Francis is the type of man upon whom the whole of the commerce of this country has been built. We can do with a great many more people of his nature and imagination. We are met to do him honour, and I think we are rightly assembled so to do. I will not detain you any longer except that I think you would all wish a message to go to him wishing him a speedy recovery, and expressing the hope that he will accept this picture as it is given—as a symbol of appreciation."

At the Health and Hygiene Exhibition, which is being held for a short period in the Waverley Market, Edinburgh, the Edinburgh Corporation Gas Department have arranged a demonstration of the ways in which gas equipment meets the requirements of the household. The Gas Department are showing modern fires which automatically light themselves, and visitors to the Exhibition are invited to ask the Gas Department representative to explain the principles of the gas-operated refrigerator.

Interim Dividends for the half-year ended Dec. 31 last, at the rate of 4%, less income-tax, on the preference shares, and at the rate of 3%, less income-tax, on the ordinary shares were declared at a recent meeting of the Directors of the Colonial Gas Association, Ltd. Exchange will be deducted from these dividends at the rate ruling on the date the dividend was declared—viz., £100 in London for £125 10s. in Melbourne. The dividends due to shareholders on the London Register will be payable in London on April 4 next.

Improvements to Increase the Working Efficiency of the Coleraine Gas Department, as suggested by the Engineer and Manager, Mr. F. G. M'Elwee, have been recommended to the Borough Council for approval by the Gas Committee. It was noted by the Committee that on making his recommendations Mr. M'Elwee had taken into account the probable increase in output during the next twenty or thirty years. The improvements recommended are estimated to cost £7,890, and include new plant and other additions to the gas-works and improvement of the distribution system in various parts of the town. To cover the cost a loan is being sought from the Government.

Scottish Junior Gas Association (Western District)

Annual Business Meeting

The Annual Business Meeting of the Scottish Junior Gas Association (Western District) was held in the Royal Technical College, Glasgow, on March 14. Mr. Alex. Bujnowski, Glasgow, was in the Chair.

Mr. W. Kirk (Hon. Secretary and Treasurer) read the minutes of the last meeting, and after these had been approved he presented the reports for the thirty-second session.

The following officers and members of the Council were then elected for the Session 1936-37:

President.—J. Webster (Port Glasgow).
Vice-President.—R. A. Maclaren (Newton-on-Ayr).
Hon. Secretary and Treasurer.—W. Kirk (Motherwell).
Council.—K. Graham (Glasgow), J. Bateman (Kilmarnock), J. Bulloch (Glasgow), W. A. Currie (Renfrew), and one other to be co-opted by the Council.

Prizes were presented by the President to the following members for Papers read to the Association:

Messrs. Leckie (1932), Webster (1933), and Bateman (1934).

After the formal business had been completed, Mr. David Fulton (Engineer and Manager, Helensburgh) addressed the members.

South London Lighting

Legality of Camberwell Decision Question

South London street lighting is still in the news; and, in spite of the regrettable decision taken recently by the Camberwell Borough Council (the legality of which, by the way, has just been questioned), there are still some staunch supporters of gas. The Lewisham Borough Council—in whose area several gas-illuminated thoroughfares are generally recognized as being of a very high standard—have referred back for the second time a recommendation by their Works Committee described as "a disgraceful attempt to foist electricity upon the Borough." The recommendation concerns Canadian Avenue—a beautiful tree-lined residential thoroughfare—the original suggestion that this be re-lighted by electricity being referred back last November. The Works Committee, however, appear determined to re-affirm their previous recommendation.

Only a short period ago it was decided to re-light another road in the Borough by gas; and in this instance the Committee must have been influenced by the question of continuity of lighting. Yet for Canadian Avenue they recommend the "Osira" system in spite of the fact that there is gas lighting in the streets at either end. A pertinent question was raised at the Council meeting as to why they should pay more for electric lighting when for less they could have better gas lighting; while the Works Committee were accused of being electric light minded. There was no word in their report to say that gas was not so good a light.

Reference has been made to the fact that the legality of the recent decision of the Camberwell Borough Council has been questioned. The contention that the resolution was *ultra vires* is based, apparently, on technical grounds, as set out in the London Government Act of 1899. Section 8 (3) of this Act requires that any cost, debt, or liability exceeding £50 shall not be incurred except upon a resolution of the Council passed on an estimate submitted by the Finance Committee. It is therefore suggested that the resolution of the Council of Jan. 15 last in regard to the street lighting is *ultra vires* inasmuch as the Finance Committee did not submit an estimate to cover the cost of the lighting equipment to be provided for in the contract, which, according to the Supplementary Agenda of the Finance Committee of March 2, totalled £36,417 for the lighting equipment.

A decision was not arrived at, however, when the meeting of the Council was adjourned; and the sequel will be watched with considerable interest.

London Juniors Go Great Western

Visit to Swindon Locomotive Works

A visit of more than usual interest was paid by some fifty members of the London and Southern District Junior Gas Association when they inspected the Swindon Locomotive Works of the Great Western Railway Company on March 11.

There is, of course, an up-to-date and quite large gas-works supplying the requirements of the Railway Shops; but the visitors, being on pleasure bent, were evidently not inclined to lay themselves open to the accusation of taking a "busman's holiday," and this section of the works was studiously avoided. It is, however, of interest to note that gas is utilized to a considerable extent in the railway works, which take a large proportion of the 400 million cu.ft. of gas produced annually by the Company's carbonizing plant. The remainder of the output is taken by a few employees' cottages and for the lighting of station and shops generally. Among the many uses to which gas is put on the works are the gas-fired furnaces in the heat treatment shops, while new automatically controlled gas furnaces have also recently been installed in the spring shop. The expanding of the wheel tyres prior to fitting or removal is also effected by a gas heater, the gas for which passes through a mixer to ensure the correct proportioning of the fuel and then to the burners set in circular formation to surround the wheel. Another purpose which gas serves is in breaking up old locomotives when they have reached the end of their useful life, oxy-coal gas cutting machines being provided for severing boiler plates, frames, &c.

The Swindon works cover an area of 323 acres, of which about 73 are covered shops, and provide employment in normal circumstances to some 13,000 people. In addition to locomotive work, the carriage and wagon shops are also situated at Swindon, some 275 passenger coaches and nearly 4,800 goods vehicles being built annually, while repairs are effected to some 5,000 passenger and 8,000 goods vehicles each year. A considerable amount of miscellaneous work such as castings, forgings, &c., for various purposes is also carried on at Swindon, the works possessing its own iron and brass foundries with an annual output of 10,000 tons and 1,700 tons of finished castings respectively.

Great interest was evinced by the visitors in all they saw; and the meticulous care which is given to the production and testing of every part which goes to make up the locomotive was demonstrated in all departments. The Company's freedom from serious mishaps is doubtless in no small measure due to this care, which is also manifest in all other phases of the Company's activities. For instance, in the event of a locomotive connecting rod breaking—an occurrence which is by no means unknown and which can lead to very serious consequences through piercing of the boiler—a safety plate on G.W.R. engines prevents the broken rod riding up. Moreover, the rods from each bloom are stamped with a reference number, and when any rod breaks under normal working conditions every other engine carrying rods from the same bloom is immediately withdrawn from service and returned to the works for replacement of its rods.

The works are equipped with two blast furnaces, and all the major casting work, with the exception of wheels, is done at Swindon. The Association watched the various stages in the construction and overhaul of locomotives from start to finish, and also inspected the various devices for testing both parts and finished engine. Particular interest was shown in the wheel balancing machine. Unfortunately, it was not possible to see the machine on which engines are tested under steam, as this was undergoing repair; it is, however, one of the very few of its kind in existence. The engine shops consist of 60 bays, 100 ft. long, on which the various stages of repair are carried out, large overhead and traversing conveyors being used to move the component parts and completed locomotives about the shops. New and overhauled boilers are tested first by water and then under steam pressure before being finally subjected to a trial run on the main line. The locomotive is subsequently put on local services for a week, and, if satisfactory, it then returns to its running shed. Some five locomotives a week leave the Swindon works, a thousand engines being repaired annually.

The visitors had an opportunity of going on to the footplate of one of the larger express locomotives which was under steam in the yard.

Gas Exhibition on the Yorkshire Coast

Successful Effort at Whitby

A very successful exhibition of gas appliances and series of cookery lectures was held by the Whitby Gas Company last week. The opening ceremony was presided over by Capt. R. Smailes, J.P., C.C., and the exhibition was opened by Mrs. W. B. Sinclair, wife of the Chairman of the Whitby U.D.C.

The exhibiting firms were Messrs. R. & A. Main, Ltd., John Wright & Co., Ltd. (Radiation Ltd., Proprietors), and Thermal Syndicate, Ltd. There was also a display of Calor Gas apparatus. The Lady Demonstrator was Mrs. M. Trainor, M.C.A., and about 1,400 people attended the ten lectures. A cake baking competition resulted in a large number of entries, the sum of £3 3s. being handed over to the funds of the Whitby War Memorial Cottage Hospital.

The exhibition was very successful from a sales point of view.

Stockton's Growing Coke Sales

Demand Exceeds Supply

Stockton's development in the sales of gas coke was the subject of an article in a recent issue of the *Northern Echo*, in which attention was called to the up-to-date cutting and grading plant installed at the Corporation Gas-Works.

Mr. W. W. Atley, Engineer and Manager to the Stockton Gas Department, tells us that since this plant has been in operation the demand for coke has become greater than supply, and he has actually had to purchase coke from outside sources. He has prepared a pamphlet calling attention to the improved quality of Stockton gas coke and explaining the facilities offered for its purchase. This pamphlet has been distributed by the meter inspectors at all consumers' houses, and the response to the offer to deliver in 3 cwt. lots has been most gratifying. The increasing local sales of coke will be greatly to the advantage of gas consumers and the Gas Undertaking.

Parkinson Stove Company's Display at Birmingham

Our photograph shows a recent exhibit of the Parkinson Stove Company at the National Trades Exhibition held at Bingley Hall, Birmingham. The City of Birmingham Gas Department also had a stand at this Exhibition, and good publicity was obtained for the Industry.

Brighter Homes Exhibition at Watford

Excellent Gas Display

The first thing a visitor saw on entering the Brighter Homes Exhibition held recently at the Clarendon Hall, Watford, was the imposing stand of the Watford and St. Albans Gas Company, which was situated opposite the main entrance.

The stand consisted of two separate sections joined by an arch. One section was fitted up with modern gas water heaters manufactured by Ascot Gas Water Heaters, Ltd., and the other was devoted to a display of cookers, fires, and other apparatus manufactured by Radiation Ltd. A feature of the "Ascot" section of the stand was a cascade of hot water from five small sink heaters. The effect of continuous and unlimited supplies of hot water was cleverly conveyed. Considerable interest was taken in the stand, which was generally conceded to be the best in the Exhibition.

A Section of the Watford Company's Display.

The lightning sketches of Miss Graves, of the B.C.G.A. Studios, drew large crowds, while a competition in which consumers had to guess the order of popularity of various gas appliances was excellently supported. Another venture, from which the Company received considerable publicity, was the *Watford Observer* Model Flat. This flat, designed by a well-known local architect, and sponsored by the town's leading newspaper, was fitted and furnished throughout by local firms. Undoubtedly the most interesting room in the flat was the all-gas kitchen, the colour scheme of which was silver and blue. In addition to a "New World" cooker, the kitchen contained an "Ascot" multi-point water heater and a built-in gas refrigerator. All these appliances were finished in a special shade of blue to match the general colour scheme. The heating of the one bedroom was by a "Portcullis" gas fire supplied by Bratt, Colbran, Ltd.

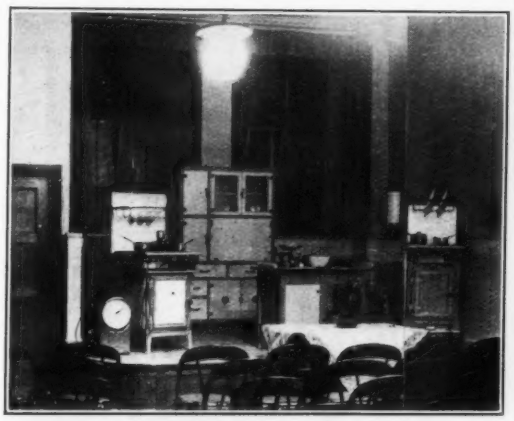
Nearly 12,000 people passed through the Exhibition in the ten days it was open, and excellent business was done, 102 orders being taken on the stand, in addition to which there were over 100 enquiries, a large percentage of which has since resulted in orders.

Sunderland Gas Company's Demonstration Room and Model Kitchen

The Sunderland Gas Company has recently opened a Model Kitchen and Lecture Theatre.

A very attractive colour scheme has been adopted in apple green and primrose with oak panelling. There is a 10-ft. square platform at one end, constituting a model kitchen on which the cookery demonstrations are carried on. The room has seating accommodation for approximately 75 persons.

The Cookery Lectures which are given every Wednesday afternoon are proving very popular and have attracted an average weekly attendance of about 60 people since their commencement.



On one side of the room are situated two fireplaces displaying different types of fires; while on the other side is exhibited a panel heater. Over the sink in the model kitchen is fixed a water heater, which is in full view of the audience. A refrigerator and two types of cookers are also displayed and are in constant use.

The kitchen is also used for lectures to the staff, while it is hoped to show here films of interest, illustrating the various developments of the Gas Industry.

South London Refrigerator Campaign

Low Hire-Purchase Terms

Following up the splendid refrigeration display at the South London Exhibition at the Crystal Palace, to which we referred in the "JOURNAL" a week or two ago, the South Suburban Gas Company are now launching a general gas refrigerator campaign in preparation for the coming summer.

Descriptive literature is being mailed to consumers, drawing attention to the advantages of refrigeration and illustrating the capacity of the medium size domestic cabinet and describing its various points. A conclusive testimonial from New York emphasizes the merits of gas for refrigeration: "One company [it is stated] supplies New York (where the refrigerator is almost as universal as the bath) with both its gas and its electricity, and is therefore able to give an impartial opinion about refrigerators. Its experience has led it to recommend, and sell, only gas refrigerators—Electrolux models, made on the same principles as these British-made refrigerators now offered to you."

It is stressed in the leaflet that no home is properly equipped without a refrigerator. It is just as much part of modern living as the radio and the telephone. The South Suburban Company are now offering the medium size cabinet on instalment purchase terms of 2s. 6d. per week, fixed free, maintained free, and guaranteed for five years. Other models are, of course, obtainable if desired.

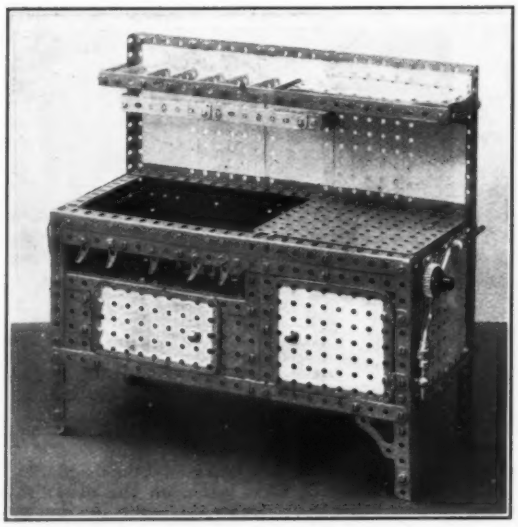
"Perfect Cooking" by Parkinson

A Catalogue-cum-Cookery Book

Planned as a companion publication to the booklet "Radiant Warmth by Parkinson" which was produced by the Parkinson Stove Company, Ltd., last autumn, "Perfect Cooking" embodies a very strong selling appeal. Tasty recipes are mingled with descriptions of the Firm's latest cookers with a balance that produces a perfect "cause and effect" theme without the slightest evidence of any noticeable demarcation.

Cut-away covers lend a modern note to the booklet, which is tastefully executed in varying shades of green, and contains many illustrations of cookers and tasty dishes. The introduction has been written by Miss Gwen. L. Hughes, Diploma, Melbourne [Emily McPherson] College of Domestic Economy, Senior Demonstrator of the Parkinson Stove Company. The publication would make a useful addition to any showroom's literature.

An Ingenious Meccano Model



The makers of Meccano claim, we believe, that there are few things which cannot be reproduced with Meccano; there cannot, however, have been many instances of so ingenious a model as that shown in our photograph above. Constructed by Master H. Middleton, son of Mr. H. M. Middleton, of the Northampton Gaslight Company, the model is a very clever representation of a "New World" cooker by the Davis Gas Stove Company.

Problems of Coal Utilization

Research and Changes in Market Requirements

Dr. F. S. Sinnatt, Director of Fuel Research in the Department of Scientific and Industrial Research, discussed last week before the Institution of Civil Engineers some major problems in the utilization of coal. He stressed the importance in the economical use of coal, not only of improvements in the design of plant, but of the selection of the right coal for a particular purpose and its preparation by cleaning and grading into convenient sizes, and described some of the important contributions connected with these factors recently made by the Department's Fuel Research organization.

In the course of the discussion which followed, Dr. E. F. Armstrong, F.R.S., speaking as a consumer and not as an engineer, expressed appreciation of the good service Dr. Sinnatt had done in emphasizing the importance of the selection of the right kind of coal for the purpose in view, and in promoting the work of the Fuel Research Coal Survey. He was one of those who thought it was wrong to burn coal directly, except under special conditions where pulverized fuels had to be dealt with, and he deplored the failure on the part of the State to encourage gas, which was all the more marked because of the help given by the State, County Councils, and Municipalities to electricity. Gas should be regarded by the Fuel Research Board and those who influenced Government policy in the matter as the ideal way of utilizing coal and its use ought to be encouraged officially. It was very sad to see that the Coal Utilisation Council, on the whole, considered gas its enemy.

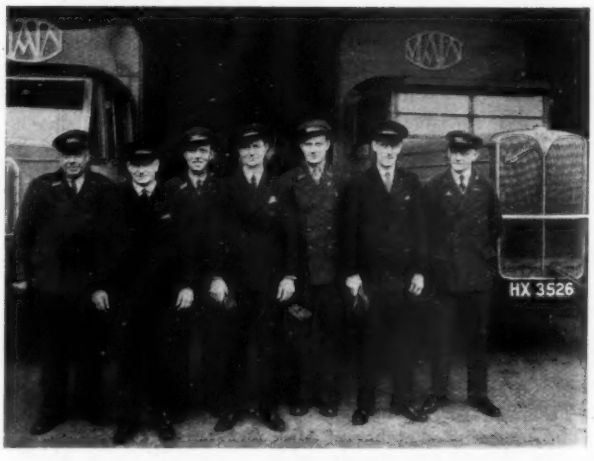
Mr. H. L. Pirie (C.U.C.) remarked that the Coal Utilisation Council was not hostile to the use of gas.

Dr. G. W. Anderson (Gas Light and Coke Company) believed the future would show that complete gasification of coal was essential if gas was to replace raw coal. Progress in the complete gasification of coal had been hampered by the absence of cheap oxygen, but to-day oxygen was available at a reasonable price, varying from 3d. to 6d. per 1,000 cu.ft. It either came as a by-product from the chemical industry or else by a modification of the Linde process, which had been considerably simplified. With the aid of this oxygen the water gas process, which was really the basis of all complete gasification, could go on continuously, the loss in blow gases being avoided and the quality of the gas not being materially changed. If the water gas reaction went on under pressure, CO_2 and CH_4 were formed at the expense of CO, and after purification chiefly from the CO_2 the gas had a value of the order of 450 to 500 B.Th.U., which was quite suitable for distribution. Also, the Fischer process used for the synthesis of petrol on the Continent could very well be adapted for the enrichment of water gas. Whatever the future might be with regard to these two processes he felt that the question was of such vital importance that it ought to be incorporated in the programme of the Fuel Research Board. It was true that The Institution of Gas Engineers was already tackling the problem from the point of view of the use of oxygen alone, but he did not think the research should be stopped there. The problem had become too vast for any particular organization or body to undertake.

R. & A. Main's Contribution to Road Safety

Silver Medal Award for Careful Drivers

The strenuous efforts of the Ministry of Transport to lessen the number of road accidents are receiving help and encouragement from many firms in the Gas Industry. A group of seven chauffeurs and lorry drivers employed by Messrs. Glover & Main, Ltd., in their southern area have been awarded the Silver Medal of the National Safety First Association for drivers who have completed five years' driving free from accidents.



In addition, three other drivers of the southern area, and thirteen operating in the firm's northern area, have also qualified for the medal. It is interesting to note that the average ground covered by each driver in the course of twelve months is approximately 24,000 miles.

The names of the seven drivers in our photograph who have received the Silver Medal are from left to right: Messrs. F. G. Baker, J. E. Hall, C. W. Norman, W. Docking, F. G. Goode, C. Leadbeater, and F. H. Pretty.

Gas Main Flooded

A Successful Underwater Pipe Repair

Das Gas- und Wasserfach records that on Dec. 27, 1935, the gas supply to a moated warehouse served by the Elbing Gas-Works failed. The supply pipe had become full of water from the Elbing River. Divers discovered that the main laid 4½ metres deep had been caught by a boat anchor and lifted about 1·60 metres. At the point where the anchor gripped the 200 mm. diameter Mannesmann tube it cracked and lifted. The aperture was covered with a soft lead plate and then wrapped with " Denso " bandage. Over this a 6 mm. thick rubber pad was placed, and this again wrapped with a double layer of " Denso " bandage. The repair was completely successful.

" Gas Washing "

Holmes' New Brochure

A new brochure on " Gas Washing " prepared by Messrs. W. C. Holmes & Co., Ltd., of Huddersfield, is very different from what is normally understood by the term " catalogue." It combines an illustrated—and very well illustrated—account of the development of gas-washing plant as manufactured by the firm with a most useful technical study of the principles of countercurrent washing.

The first section to which we have referred deals in turn with their rotary brush washer, the D and L centrifugal washer, and, finally, the " Multifilm " static washer first constructed in 1931 and since built in single units up to 800,000 cu.ft. per hour for benzole recovery and of 1½ million cu.ft. per hour for dehydration. The principle of construction of this washer is such that it can be designed to deal with large liquid throughputs such as are characteristic of benzole and gas dehydration plants, or for the use of minimum rates of liquid flow as in cases of naphthalene and ammonia removal.

The highly useful technical section considers washing efficiency, sectional contacts, incomplete contacts, irrigation rates, irregularities in washing, and mechanical faults. The whole treatment is exceedingly clear.

Scottish Juniors Learn How Refractories are Made

Visit to Messrs. John G. Stein & Co., Ltd.

About forty members of the Scottish Junior Gas Association (Western District) enjoyed a very interesting visit to the Castlecary Works of Messrs. John G. Stein & Co., Ltd., on Saturday, March 21.

The research and testing laboratories were first inspected. The contraction and expansion when heating to 1,400° C. and the thermal conductivity, the compression strength, the permeability to gas, the resistance to corrosion by slag and to the action of carbon monoxide, are all determined under conditions approximating to those obtaining in the various furnaces for which the bricks are intended. The resistance to spalling by sudden changes of temperature is measured, and the softening points are found by the Seger cone method, using platinum resistance furnaces capable of giving temperatures up to 2,000° C.

The manufacture of the refractories was then inspected. The clay, wound from a 12 ft. seam, 60 fathoms deep, is crushed in edge-runner pan mills, screened and elevated to storage hoppers. From these hoppers the clay is conveyed by chutes to pan-mills where it is mixed with water and then by buckets to the brick-making machines each of which produce 1,200 bricks per hour. The bricks, after drying on the heated floor, are built into the continuous kiln. The kiln has a total length of 1,000 ft. and is operated in four sections, each of which is sub-divided into units, and is worked in a definite rotation. One unit is emptied while its neighbour is filled. The freshly charged bricks are slowly and uniformly heated by the hot gases from the cooling fired bricks. By regulating the firing, the temperature in each unit is increased at a definite rate, which is observed from thermocouples inserted through the roof of the kiln, until the final temperature of heating when the firing is stopped and the bricks cooled slowly by the gases from the preceding units. The same number of units are fired each day, but the position of firing and of maximum temperature moves on two units per day while the emptying and filling of the units proceeds in the opposite direction at the same rate.

The method of manufacturing the silica bricks is similar to that for ordinary firebricks, but the drying is carried out more rapidly to prevent crumbling. Specially shaped bricks are made in hand presses.

After the tour of inspection the members were entertained at tea, when Mr. A. Bujnowski (the President) on behalf of the Association thanked Col. Stein and his staff for their hospitality; this visit, he said, had been very profitable and interesting.

Col. STEIN, replying, said they looked upon the visit as a compliment. He said that his father, Mr. J. G. Stein, when he founded the Company 34 years ago planned the works for an output of 110,000 bricks per day. The works were gradually extended, the ultimate capacity being reached in 1927. The works had been working at its full capacity of 110,000 bricks per day since 1929.

A Helpful Cooker Catalogue

Main's New Publication

The 1936 issue of the " Main " cooker catalogue will be welcomed as a distinctive piece of showroom literature. It gives the fullest details of the firm's latest cookers, and also shows how these appear in various kitchen settings.

The Deluxe " Mainamel " models, which now embrace the popular " Sussex " series, have been reproduced in colours by direct photography, and the inclusion of these illustrations in the catalogue will be a helpful guide to gas consumers in selecting a cooker for a particular scheme of decoration.

Many fresh features are shown in the booklet, including the new standard single plate-rack (which can be obtained in black or chromium finish) and the stamped double plate-rack, enamelled to match the finish of the cooker. Both types of rack, which have improved means of fitting, are now provided with a patent levelling device which permits of any adjustment necessary to obtain a perfectly horizontal rack.

Athletic and Social

Bath Annual Staff Dinner: Co-Partnership Scheme Inaugurated.

Details of a Co-Partnership Scheme were given at the annual staff supper of the Bath Gas Company at the Drill Hall, Lower Bristol Road, on Thursday evening, March 12.

A company of about 380, which included members of the Chippenham and Corsham staffs, spent a delightful evening, and their pleasure was enhanced by the presence of the Directors, who hitherto have not attended this yearly re-union. A particularly gratifying feature of the occasion was that it was an unofficial celebration of a record year in the sale of gas and gas appliances.

The Chair was taken by Mr. J. Wesley Whimster, Engineer and Manager, and an interesting announcement concerning him was received with loud applause. It was that, after 21 years as " leader " of the staff, he had been invited to join the Board as a Director.

The Directors present were Messrs. H. Stanley Taylor (Chairman), E. S. Franklin, R. C. L. Fuller, K. Macdonald, and J. F. Wilkes. Others attending included Messrs. W. Blundell (Secretary), A. Tran (Assistant Engineer and Manager), W. Atkins (Distribution Engineer), J. Kaye (Works Superintendent), and F. Clark (Chief Clerk), who was mainly responsible for the supper arrangements.

Following the observance of the loyal toast, the Chairman proposed the health of the Directors of the Company. He wished to take that opportunity, on behalf of the whole of the staff, of congratulating their Chairman, Mr. Stanley Taylor, on his election to the Presidency of the B.C.G.A. They had present that evening two members of the staff who had been with the Company for over 50 years. One was Mr. T. Alexander, who retired some years ago after 54 years' service, and the other was Mr. Albert Smith, who had been with them for 52 years and had not retired yet. He thought the pensioners and all who were approaching the pension age should be very grateful to the Board for having granted pensions at the age of 65. This meant a considerable sum of money, and last year it amounted to £1,600.

The Chairman of the Board, Mr. H. Stanley Taylor, who was given a most enthusiastic reception, responded. He said that it was the first time he had had the pleasure of attending the annual supper, and hoped it would not be the last. It was great pleasure that they were able to announce the details of the Co-Partnership Scheme. That it had taken so long to come into being was not the fault of the Directors. They had been working hard at it, but it was a complicated matter, and they had to observe a number of regulations by the Board of Trade.

The dinner was interspersed with a number of excellent musical items.

The Moisture Content of Coal

AND ITS RELATION TO SOME OTHER PROPERTIES

A contribution from the South Metropolitan Gas Company's Coal Laboratories, Newcastle-upon-Tyne.

Increasing attention has been paid in recent years to the question of moisture in coals. In Russia, Germany, and the United States of America, where much of the coal is of the lignite type with water content of the order of 20%, more enquiry has been the rule than in those countries where the coals have a lower moisture content.

The fundamental aspects of this partnership between water and coal have been investigated, and it now appears that the retention of water by coal is most probably a phenomenon due to the structure of the coal and involving the physical properties of adsorption and capillarity. Coal is envisaged as a solid, traversed to a greater or less extent by tubular pores of minute size and of varying diameter. These pores are capable of retaining water by capillary action and at the same time provide a large internal surface for molecular adsorption.

Buyers of coal, who naturally regard water with disfavour, have been desirous of distinguishing between what we might call "unavoidable" moisture—namely, that present in the coal as it occurs in the seam—and "avoidable," due to wet conditions in the pit or inadequate protection of the mined coal from the weather. It has thus become the custom to divide the moisture of a coal into two parts—(1) that removed by air-drying, or "free moisture," and (2) that not removed by air-drying, or "inherent" moisture, or in other words the avoidable and unavoidable moisture.

Tests devised to give this differentiation, carried out, as they usually are, under very variable conditions of humidity and temperature, gave, as our present knowledge of the state of water in coal leads us to expect, figures of no very obvious constancy or relation to other analytical data. It is well known that, speaking very generally, the lower the rank of a coal the greater the proportion of moisture retained after air-drying; peat lignite and brown coals having "inherent" moistures of 20% or more, while "hard" or bituminous coals retained 5% or less.

If we consider a piece of coal which has been submerged in water and simply drained, we can envisage water which presents surfaces varying from the plane surface of the water wetting the outer faces, through the slightly curved surfaces of the water in the larger pores, down to surfaces of very marked concavity in the most minute capillaries. This implies that the vapour tension corresponding to these different degrees of concavity varies for any given temperature from the normal value for a plane water surface, right down to zero. If, then, in drying coal we choose a medium whose aqueous vapour tension is intermediate between that of a space saturated with aqueous vapour and zero, we can only remove that portion of the water of which the aqueous vapour tension is greater than that of the medium. Further, by varying the aqueous vapour tension of the medium we can remove as much or as little of the water as we please.

In experiments conducted in this laboratory it was decided to ascertain what amounts of moisture were retained by coals under certain controlled conditions. These were chosen arbitrarily, the selected temperature being 25° C. with air of relative humidity 50% as the drying medium. The drying was carried out in a simple water-jacketed oven fitted with a thermostat for temperature control, and was continued until equilibrium had been established under the selected conditions. In most cases the time required was about 30 hours, but some coals needed a much longer period.

Interesting Results from Commercial Samples.

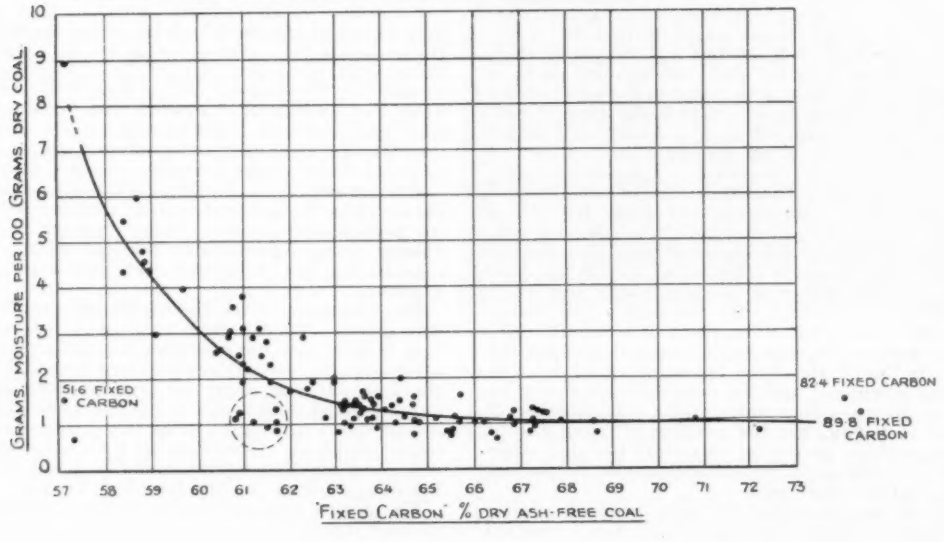
About 100 samples have been tested, mostly commercial samples from the coalfields in the North of England, and the results have proved to be extremely interesting. It has been found that the amount of moisture retained by a coal under these or similar controlled conditions is, generally speaking, a function of its "fixed carbon" content reckoned on the dry ash-free coal, the "fixed carbon" content being taken as at least a general indication of the rank of a coal. The plotted results are shown in Curve 1, the moisture being expressed as parts of water retained by 100 parts of coal. A fundamental connection between these quantities is obvious. Indeed, for a large proportion of the coals tested it is possible to predict the moisture content, after drying under specified conditions, with surprising accuracy.

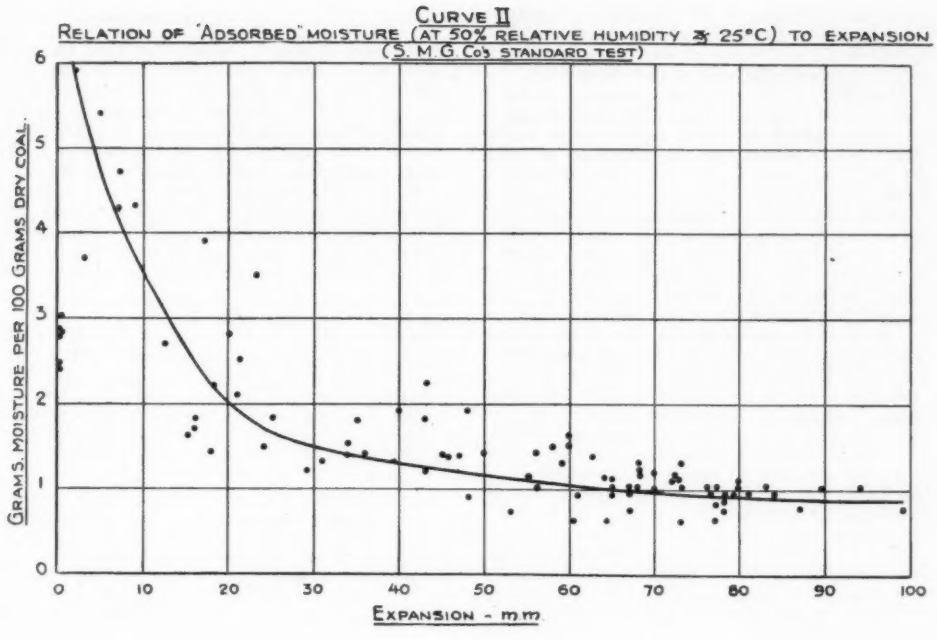
The form of the curve suggests a relation of the "Compound Interest Law" type—*i.e.*, $y = Ae^{-bx}$ where A and b are constants, y the adsorbed moisture, and x the fixed carbon.

It is also obvious that there are a number of fluctuations from the general relationship which cannot be accounted for by the usual experimental errors in determinations of

CURVE 1.

RELATION OF "ADSORBED" OR "INHERENT" MOISTURE (AT 50% RELATIVE HUMIDITY & 25°C) OF COALS TO FIXED CARBON (DRY ASH-FREE BASIS)





this kind. In investigating the reasons for these, it was further discovered that this moisture content was also closely related to the swelling power of a coal.

Since the year 1926 it has been our custom to measure the swelling power or expansion of coals in an apparatus of the dilatometer type. A pellet of coal is heated at a constant rate and the degree of swelling over the plastic range of the coal is measured. The moisture figures referred to were plotted against the values obtained for the swelling index, and the resulting curve is shown in Curve 2. The relationship between these values is again very striking for the great majority of the coals examined. Some interesting deviations are again evident as with the moisture-fixed carbon curve. If the swelling property is regarded as an index to the coking qualities of a coal, it follows that this moisture determination can also indicate, at least approximately, the coking values of some coals.

No special investigation of the cause of the variations from the rule met with during these experiments has yet been possible, but meanwhile some of these may be briefly considered.

One sample which is right off Curve 1 with moisture 0·6% and fixed carbon 57·3% is a selected lump of durain of low ash content. Its position is normal on Curve 2. Another is a very dull coal with moisture 1·5% and fixed carbon 51·6%, and is so abnormal that it cannot be conveniently shown on the curve, but it, too, is normal on the swelling curve. A group of seven samples with moisture about 1% and fixed carbon from 60·8% to 61·8% is derived from the same seam and the same area, and these contain a high proportion of durain. This group falls below Curve 1 and again is placed normally on Curve 2. The behaviour of this group suggests the possibility that this moisture value may be characteristic for each seam or some considerable part of its area. Some support for this suggestion is derived from the results of plotting the values for moisture obtained by ordinary air-drying, against the fixed carbon, for the samples investigated by the Fuel Research Board from the Yard, Main, Hutton, and Brockwell seams of the Northumberland and Durham coalfields, when a rough grouping for each seam is noticeable. Here again a relationship of the same kind can be traced, but there are numerous exceptions.

Further examination of the divergencies as a whole shows that if we take the swelling and moisture of the coals on the curve as normal, then for any given fixed carbon all the coals with a moisture content too low have an unduly high swelling index, and *vice versa*. These divergencies might be explained on the basis of at least two main coal components, one of low swelling and high adsorbed moisture, and the other a high swelling material with low moisture. The rank and fixed carbon of these two components may vary, with a related variation of the actual magnitude of swelling and adsorbed moisture, but for any fixed carbon content they seem to be related as indicated. Normal coals which fall on or near the curve may contain unknown but standard proportions of the two components, while those above or below contain more of one or the other.

It may be that these two components correspond in some way to the banded constituents vitrain and durain. On this hypothesis vitrains should contain more moisture than the durains associated with them. The few durains examined by us all had low moisture contents, but tests have not yet been made on the corresponding vitrains. The descriptions of the seams and results published by many investigators also show, however, that the great majority of durains contain less moisture than the bright coals in the same section. Such a conception seems to agree very well with the deductions of Leigh Fermer from his investigation of the coals of Korea and Bokaro, and of certain Indian vitrains and durains.

S. Iki, working on 12 Japanese coals, found that a relation existed in the case of these coals between the "coking power" determined by the Campredon test, and the moisture content determined under constant humidity conditions. He further resolved certain of these coals into their α, β, and γ components with pyridine and chloroform, and showed that the α component had the highest moisture absorbing property, and the γ component the lowest, while the β was intermediate. The γ component is generally considered to be responsible for the caking and swelling properties, and it is therefore possible that the two hypothetical components suggested above may correspond to the $\alpha + \beta$ fractions on the one hand and the γ constituent on the other. Hence the position of a coal on the curve may indicate the relative proportion of γ to $\alpha + \beta$ constituents.

It would appear, therefore, that no absolute uniformity in the quality of a coal can be expected unless these components are present in the same proportions. Until some method of determining these can be devised, we should not expect to find close agreement between the results from commercial samples, and the general relationship which undoubtedly exists between the chemical and physical properties of coals and their rank.

Moisture Content and Rank.

It seems a logical conclusion that the moisture content of a coal after drying under specified conditions depends fundamentally on its rank, and divergencies from the rule are to be attributed to variation in the proportion of coal constituents, which represent the metamorphosed products of different types of vegetable substances segregated in the earliest stages of the coal forming process.

In order to determine the variation of the adsorbed moisture with drying conditions, 20 coals, selected from the range of coals available, were dried in an oven at 25° C., the humidity of the drying being varied from 80% relative humidity, thence to 60, 40, and lastly 25%, the drying being continued at each stage till the weight of the coal was constant. At the completion of this process the dried coals were exposed to an atmosphere saturated with aqueous vapour at 25° C. The results showed that a similar relationship to the "fixed carbon" content exists for the moisture content determined at any given humidity.

Our experience confirms the results of other investigators

with regard to the contraction of the capillary structure of coals which takes place on drying. A coal which has once been dried will never re-absorb at any given humidity as much moisture as it originally held at that humidity.

The original structure in the wet state appears to have elastic properties. On drying, this elasticity is lost and a contraction occurs, the capillaries then becoming inelastic and stable in structure. While this phenomenon is very marked with the younger coals it becomes less significant as the rank of the coal increases, and in the bituminous coals is of only small significance. Further, even after the structure has been stabilized by drying it is found that for an atmosphere of given humidity the water content of a coal depends on whether the coal is being de-hydrated or re-hydrated. Thus between the vapour pressure curves obtained by de-hydrating and then re-hydrating a coal, a loop or surface is found analogous to the well-known "hysteresis loop" in the curve connecting the magnetic state of iron with the magnetizing force. The extent of this hysteresis effect is greater, as might be expected, with those coals of high "adsorbed" moisture content, and is probably due to what might be called a reluctance of the water to leave or enter the pores, the reason for which is unknown. Hence, the amount of moisture retained by a coal after drying from the wet state in an atmosphere of given humidity is always somewhat greater than that which the dry coal re-absorbs when exposed to the same atmosphere. It is therefore necessary, particularly in the case of low rank coals, to arrive at the vapour pressure equilibrium from one particular direction. Normally, of course, the coal must be dried down to the selected humidity.

Conclusions.

It is suggested, in conclusion, that the moisture in a coal determined under controlled conditions is a measure of a definite physical property and depends fundamentally on its rank, but is affected by variations in the proportion in which certain constituents are present. Some clue to this variation is afforded by the magnitude of the swelling property, and also, almost certainly, by its calorific value.

It is highly desirable that some standard method of air-drying coals should be agreed upon as soon as possible. The figures which would then become available from a wide range of coal types, would, we feel sure, aid considerably the elucidation of the problem of the constitution of coal.

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Low-Temperature Carbonization

A new process for the manufacture of smokeless fuel from non-caking or weakly caking coals.

by

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In this article the suggestion is put forward that it is necessary to consider the question of low-temperature carbonization on a much broader basis. Several fundamental factors should be taken into account, and it is proposed to discuss these in relation to a newcomer in the field of low-temperature carbonization—the process of the Coal Research Syndicate for the manufacture of solid smokeless fuel. A description of the actual plant in operation in this country will be given in a subsequent article. In broad outline, however, the process was developed in the first instance for the large-scale treatment of shale for the recovery of oil, in which it has been entirely successful. Several years' research work has culminated in the erection of two full-sized units for the carbonization of coal for the production of smokeless fuel.

The process possesses certain unique features and, it is claimed, produces a fuel having exceptional qualities, but it is suggested that the question does not resolve itself into a simple comparison of costs between the various systems although, it may be said, the C.R.S. process shows the possibility of effecting substantial economies. Nor does the question entirely depend upon the profit it may be shown capable of earning for the time being with the ruling coal prices.

It should be emphasized that the process has been developed primarily for the manufacture of smokeless fuel from the non-caking or weakly-caking coals of fairly high volatile content such as are supplied to the house coal market for consumption in the open grate.

On the other hand, developments in the manufacture of smokeless fuel by other low-temperature processes have been almost exclusively directed towards the use of caking coals and slacks such as are already used in large quantities by the gas and coke oven industries. Fuel obtained from the carbonization of these cheaper caking coals will increasingly displace the hard non-caking lump coal now sold to the house coal market. This leads to the logical conclusion that this is an operative factor which will tend progressively to disturb the balance of the coal market as progress is made towards the ultimate displacement of the 40,000,000 tons of domestic coal annually consumed.

The importance of the matter warrants attention from both producers and users of coal destined for conversion into smokeless fuel, for it is likely the latter will be made in increasing quantities from the cheapest class of caking coal.

Future Market Value of Caking Slacks.

From the carbonizing industry's point of view—and this would include not only the low-temperature processes but also the Gas Industry, the growing demand for the caking slacks must ultimately result in higher market prices for this class of coal. From the coal industry's viewpoint, the fact that the manufactured smokeless fuel, whether it be low-temperature or high-temperature coke, made from the cheaper caking coals will displace in the house coal market a higher priced non-caking coal must affect the sale of the latter in increasing measure. It is largely upon the sale of the hard non-caking household coal that the collieries at present depend for their revenue.

In the writer's view there is no reason why the Gas Industry should not take up and develop the manufacture of free burning solid smokeless fuel. Already it produces and sells a considerable quantity of high-temperature coke, but while this is eminently suited for combustion in closed stoves and water heaters, it is not so suitable for the open fire where little draught is available and the grate installed is of the ordinary coal-burning type. Of course, special grates can be fitted, and many gas undertakings are disposing of large quantities of high-temperature coke for burning in the open fire. The quantity that can be made for this purpose, however, must depend upon the demand for gas. The question of increased production of coke cannot be considered without regard to this factor.

Catering for a Growing Demand.

Apart from the question of the respective merits of high and low temperature coke for the open fire, it would not appear possible to replace by gas coke more than a small proportion of the 40,000,000 tons of raw coal consumed. Moreover, a section of the public will insist on using a free burning fuel in their open fires. There does, in fact, appear to be a strong case for gas undertakings to produce in addition to their high-temperature coke, a low-temperature

smokeless fuel, the production of which could be increased irrespective of the amount of gas made.

The large gas undertakings are in a most favourable position for becoming the universal providers of smokeless fuel in the various forms in which it will be required. They are already suppliers of gaseous fuel and of considerable quantities of solid fuel and they possess an established organization for the sale of their products.

In any case, whoever takes up production of smokeless fuel, the logical method is to develop along parallel lines a process which could utilize for the manufacture of such fuel the type of raw coal it displaces. In this way the balance of the market for the different varieties of coal would not be unduly disturbed as the situation developed.

It may be asked why development on these lines has not been more in evidence, especially in view of the fact that the carbonization of a non-caking coal would not appear to offer so many technical difficulties as does a caking coal or slack, particularly if the latter has high swelling properties. There are a number of explanations. In the first place, the majority of low-temperature processes have originated from ideas taken from the practice of carbonization as developed by the older established industry of gas manufacture which exclusively employs externally heated retorts or chambers. Secondly, the lure of cheap coal—and, it may be said, not always for the purpose of showing increased profits, but to enable a profit to be shown at all. There are many impracticable examples of methods of low-temperature carbonization to be found which, if their promoters had not based their figures upon the use of the cheapest caking slacks, would never be shown capable of operating at a profit.

Carbonization of Higher-Priced Coals.

From a technical point of view, the externally heated retort type of low-temperature plant does not appear suitable for the production of a carbonized product of uniform and sufficient volatile content from a hard lump non-caking coal, and at the same time to operate with sufficient economy to justify the possibility of paying from 3s. to 5s. per ton more than is at present paid for a caking slack coal.

Yet an increasing demand for the caking coals, not only for the production of solid smokeless fuel but from the parent industries, coupled with a proportional decrease in the demand for the higher-priced hard coals, will result in an increasing appreciation in the value of the caking slacks.

As has already been stated, no process has heretofore been evolved for full-scale commercial working which has held out promise of such reductions in capital and working costs as would justify the treatment of high-priced hard coals, and at the same time fulfil the exacting requirements in quality and uniformity of a smokeless fuel of to-day.

It is claimed that the process of the Coal Research Syndicate fulfils these conditions and enables it to utilize the high-priced non-caking coals as supplied to the house coal market, and to treat them on a commercial profit-earning basis.

The more important advantages claimed for the Coal Research Syndicate process are:

(1) Low capital cost of plant.
(2) Successful bulk carbonization with uniformity in the quality of the resultant solid product.
(3) Low operating cost.
(4) Simple and cheap control.
(5) Low maintenance cost.
(6) Extreme flexibility in working, with saving in starting and stand-by charges.

Collateral Development.

In conclusion, it is desired to emphasize that no claim is made for the universal adoption of low temperature carbonization plant for the treatment of the hard coals to the exclusion of other processes utilizing the caking varieties, but for collateral development along lines which appear essential for the reasons set out in this article.

UNDERLYING PRINCIPLES OF Gas-Operated Refrigerators

At a Meeting of the Midland Junior Gas Association at Birmingham on March 5, Mr. S. S. SHERLOCK, of Electrolux, Ltd., gave a Lecture on "Refrigeration." The President, Mr. F. L. Atkin, was in the chair.

Before dealing in detail with the gas-operated Electrolux refrigerator it might be advantageous to satisfy ourselves that we are conversant with the underlying principles of obtaining a lower temperature within a confined space. For this purpose it is proposed to make use of a cylinder fitted at the top with a suitable release valve containing any one of the many volatile liquids which have suitable characteristics to ensure that evaporation can be obtained at temperatures sufficiently low for the purpose bearing in mind that we require to obtain results that will give us a temperature within the refrigerating cabinet of between 40° and 50° F.

You are, therefore, asked to imagine that the cylinder contains liquid ammonia and by opening the valve, the vapour produced as the ammonia takes up heat from the surrounding air will be released through the valve into the atmosphere outside the cabinet which has been built around the vessel. As we are abstracting part of the heat in the cabinet which is being used to change the state of the ammonia liquid into vapour, so we are, by the removal of this heat, reducing the temperature. This process of removing heat from within the cabinet through the medium of liquid is the underlying principle generally employed in refrigerators of the absorption or compression type. For obvious reasons it is not a practicable proposition to use this simple arrangement for producing refrigeration in the home. Quite apart from the difficulties in handling the refrigerant, it is not possible to ensure that an even temperature which is so necessary for the storage of foodstuffs can be maintained.

It is indeed fortunate that a gas-operated refrigeration system has been evolved which will allow for the conditions which we have brought about in this simple manner to be carried out automatically by the simple application of a small gas flame, and it is this design which I am now pleased to describe to you. This is known as the Electrolux gas-operated refrigerator.

Before describing the actual design, it must be emphasized that the refrigerator is required for service throughout the whole of the year and therefore must be capable at all times of giving the service that is required from it without attention on the part of the user.

The Unit Explained.

The simplest type of Electrolux refrigerator is built up of a series of steel vessels connected by a number of pipes. The system is filled with the refrigerant together with water and hydrogen which are used as absorbing and pressure reducing agents within the system. In the design of the Electrolux apparatus the inventors have taken advantage of a well-known physical law. Namely, that the evaporation of liquid does not depend upon the total pressure existent, but will take place provided that the pressure exerted on to the surface of the liquid by its own vapour is sufficiently low. In actual fact the same results as those obtained in our very elementary refrigerator are achieved within the evaporator of the Electrolux system by employing the hydrogen within the system to bring about a reduction in the working pressure of the ammonia within the evaporator. Provided this part of the cycle of operation in the unit is understood, the remainder is merely a matter of tracing the course of the refrigerant through the unit.

Remembering that the refrigerating unit is built up of three main vessels with connecting tubes, we will commence the cycle at the boiler vessel to which a small gas flame is applied in order that we may drive off some of the ammonia which is held in this vessel in a solution of water, and suitably prepare the ammonia vapour for its admission into the evaporator. This is brought about by cooling the ammonia vapour within the tubes which are connected to the top of the boiler at one end. At the other end the actual cooling is effected by fitting fins which are placed in contact with the condenser tubes, and by this means it is possible to obtain sufficient liquification of the ammonia vapour to ensure that it is converted to a liquid before it enters the evaporator. In the evaporator the ammonia evaporates and extracts heat from the surround-

ing air, thus producing a lower temperature, and it is within this vessel that hydrogen is introduced to allow for a lower working pressure of the ammonia. With the evaporation of the ammonia we then have a mixture of ammonia and hydrogen, and these gases being heavier than the pure hydrogen which is being introduced at the top of the evaporator fall to the bottom of the evaporator where they are carried through a tube to the third vessel, the absorber.

Final Stages of the Cycle.

At the base of the absorber the ammonia vapour is absorbed into the water which is contained in this vessel, and the hydrogen is freed and passes to the top of the absorber and thence back into the evaporator again. We now have a mixture of water and ammonia in the base of the absorber, which we require to return to the boiler in order to complete the cycle of operation, and at this juncture it might be mentioned that this operation, which under normal circumstances would call for a mechanical pump and suitable driving force, is satisfactorily performed by part of the heat from our small gas flame, used to drive off the ammonia from the boiler, this heat being applied to a coil which is located at the base of the boiler, the extreme end of this coil being connected to the boiler. The effect of this heat is to cause bubbles of gas to be formed, which rise up the pipe carrying the liquid with them.

The cycle is then complete except that it needs to be explained that there is a connecting tube from the lower end of the boiler to the absorber in order to allow for the water level in the absorber, which is required for the absorption of the ammonia gas from the evaporator to be constantly replenished.

It is necessary to fit external cooling fins to the absorber to ensure that the water contained within the unit is kept at a sufficiently low temperature readily to absorb the ammonia vapour passing from the evaporator.

This explains the basic principle of the cycle of operation, but there are many additional refinements which are incorporated in order to ensure that the overall performance of the unit is satisfactory. Mention must be made of the rectifier, the gas heat exchanger, and the liquid heat exchanger, together with such additions as the pressure equalizing vessel and high temperature radiator, which are now fitted to the larger models.

It is possible by means of a suitable gas equipment in which is included a thermostatic device, to control the periods of operation of a unit of this type in such manner that the temperature maintained in the cabinet into which the evaporator is fitted, will be entirely suitable for meeting the requirements of a domestic refrigerator.

Discussion.

In proposing a vote of thanks to the lecturer, Mr. F. A. JENKINS (Leamington) said the operation of the refrigerator involved a complicated cycle which would not have been so easy to grasp without so lucid an explanation. He asked what was the object of the peculiar shape of the orifice of the burner nipple, and whether it was designed to prevent interference or to show evidence of interference.

Mr. E. T. PICKERING (Birmingham) seconded, and the vote was carried with acclamation.

Mr. SHERLOCK said the unusual design of the burner jet was associated with the top aeration control. They required a burner capable of dealing with varying flows. A control having four positions of adjustment is employed on the smaller model Electrolux refrigerator, allowing for an increased flow from positions (1) to (4). Further, they needed a burner which would maintain a Bunsen condition at all control settings. Experiments had enabled them to secure the required type of flame by using a particular design of jet or nipple, and the effect of this design was to allow of better mixing within the burner and to ensure satisfactory conditions of combustion.

Mr. F. J. BENGOUGH (Birmingham) asked what was the capacity of the burner and type of governor installed, for what differences was it reliable, and did the pressure reach a point when it became beyond the capacity of the governor.

Mr. SHERLOCK, with the aid of the blackboard, compiled an information chart of the controlling features of the refrigerator, dealing with capacity, governed gas pressure at the testing point on the burner, the location of the baffle in the boiler tube, the range of pressures for which the standard control was suitable, and hourly consumptions for each model. It was explained that the models were set for a standard calorific value of 500, and all that was needed for different calorific values was a slight adjustment, the required information being available in the literature despatched with each refrigerator. The lecturer gave a demonstration of control setting for the manual control on the model LDA and emphasized the importance of using the correct size of jet. He then pointed out the importance of efficient maintenance and gave a practical demonstration of burner and flue cleaning, emphasizing the importance of exercising care in connection with adjustments to the burner assembly after dismantling. He also explained the use and position of the baffle hanging inside the boiler tube and drew attention to the information given on the chart which he had prepared for checking this point after service. In reply to a question regarding defrosting, Mr. Sherlock advised that the door should not be left open in the hope that the air temperature would cause the machine to defrost. He pointed out that a refrigerator was required in service for 365 days in the year, as it was now regarded as a necessity and not as a luxury, and said that defrosting could be satisfactorily obtained by turning the control of the refrigerator to the " Off " position and allowing the de-frost water to be collected into the drip tray provided. During the period of defrosting refrigeration was still taking place within the cabinet by the action of ice melting and there was no need from this standpoint for the cabinet to be emptied of its contents. In general practice, defrosting should be carried out at intervals of one month.

The lecturer also dealt with the question of " fumes " and pointed out that apart from the extremely remote possibility of a defective unit there would be no ammonia fumes either discharged into the cabinet or into the atmosphere outside. Dealing with the question of food tainting, Mr. Sherlock pointed out the need for covering certain foodstuffs, in particular milk, butter, cream, fish, and cheese, as owing to the small storage capacity of the refrigerator compared with that of the average domestic pantry, the closer proximity of the foodstuffs rendered greater the risk of contamination. He again emphasized that every part of the refrigerator was tested before leaving the works and the unit was foolproof.

Replying to a question as to the minimum temperature reached in the refrigerator and the amount of work which could be performed by the small models, Mr. Sherlock stated that the minimum temperature under normal conditions would approximate 30° F. inside the cabinet, but as many factors had a governing effect upon the figure reached, no guarantee could be given that such a low temperature could be continuously obtained with the standard type of domestic cabinet. It was then pointed out that with a cabinet temperature of approximately 40° F. the actual radiator temperature, which is that part of the unit into which the ice drawers are fitted, would fall considerably lower than this, as the radiator was most certainly the coldest part of the refrigerator.

The PRESIDENT, Mr. F. L. Atkin, enquired as to the pressure at which the refrigerating unit operated and how the refrigerator stood in regard to Home Office regulations.

In reply, Mr. SHERLOCK stated that the pressure within the unit was well within the limits for which the apparatus was designed, and the actual figure was within the limits for which certain mineral water bottles were designed. The unit was subjected to an extended and thorough test at the factory and he was of the opinion that this question could be most readily answered by pointing out that although the matter had been the subject of very full investigation by insurance companies and other interested bodies, the refrigerator was accepted as part of the ordinary household effects without additional premium. The lecturer admitted that in isolated cases a fracture of the refrigerating unit had occurred, but in no case within his knowledge had this resulted in any personal injury or damage to property. The largest type of refrigerator his Company had so far produced was of 45 cu.ft. capacity. One of the objections to such cabinets working on the absorption principle was that the size of the unit necessary was out of proportion to the size of the cabinet for which it would be suitable. Answering questions regarding food storage and ice cream making, the lecturer stated that temperatures between 40° and 50° F. were best for the storage of foodstuffs in the domestic refrigerator and pointed out that with temperatures lower than this there was a considerable risk of certain foodstuffs becoming frozen. In connection with the preparation of ice cream within the refrigerator, Mr. Sherlock stated that whereas water ices could be obtained with a radiator temperature only slightly lower than 32° F., many cream mixtures would not freeze until a considerably lower temperature was obtained. When preparing ice cream he mentioned the necessity for allowing the refrigerator to operate at its maximum setting providing the lowest temperature for a period of several hours. Answering a question on insulation, Mr. Sherlock pointed out that the insulation used for the cabinet was compressed granular cork, the whole of which was treated with bitumastic composition in order to prevent moisture entering the cork and thereby reducing the efficency of the insulation. Mr. Sherlock, stressing the value of gas operation, said it was gratifying to know that success had attended the production of air-cooled cabinets capable of performance which compared very favourably with those which were electrically operated. Moreover, the modern air-cooled gas-operated refrigerator gave a performance in all respects as suitable for the requirements of a domestic refrigerator as that of their previous water-cooled models. Replying to a question in connection with the length of life that might be expected from refrigerators manufactured by his Company, Mr. Sherlock mentioned that although most of the data which had been compiled in this connection and tests which had been carried out had been completed on their water-cooled models, he was glad to be able to say that the expectation of life of the modern air-cooled refrigerator would cover sufficient years to satisfy anyone that the performance compared favourably with machines of other manufacture. He also mentioned that the actual unit service on the refrigerator was extremely small and represented less than one visit per unit in ten years.

Mr. Sherlock then explained the method of control of the gas flow and heat, and said the Gas Industry had given a sound answer to the electrical industry by supplying the necessary adjustable apparatus. The models shown were silent in working and this was an advantage over many of the electrically-operated domestic refrigerators.

London and Southern District Junior Gas Association

A Meeting of the London and Southern District Junior Gas Association was held at the London School of Hygiene and Tropical Medicine on March 13—the President (Mr. J. M. Webber, of Croydon) in the Chair.

A departure from the usual practice of reading a Paper and subsequently discussing it was tried by way of an experiment at this meeting. Two subjects were introduced for general debate, each subject being formally proposed and opposed by members before it was thrown open for debate. That this innovation proved popular was evident from the enthusiasm with which members entered into the discussions, and at the conclusion of the meeting those present voted unanimously for a repetition of this experiment next session. The President emphasized at the outset that the remarks of the proposers and opposers of the motions did not necessarily represent the views of the individual speakers themselves.

We publish below a *résumé* of the two debates.

(1) *In the Opinion of this Meeting*

THE MODERN GAS APPLIANCE IS BECOMING TOO COMPLICATED.

Mr. A. R. TARRANT (Croydon), introducing the case in support of the motion, said that the complications on gas appliances had lately become so numerous that he thought the best way to deal with the subject was to say one or two words about the various appliances themselves.

First the cooker—most common of all gas appliances. Naturally the first thing that came to one's mind was the automatic oven control. Now this—according to the instructions—cooked the dinner entirely automatically and without supervision; also it provided identical results every time. But one often heard on the district that consumers did not cook absolutely according to the directions set out either in the cookery book or on the chart supplied with the cooker. In other words, they had experimented and had discovered that more satisfactory results could be obtained by using another mark or setting. Furthermore, it was said that once the food was put in the oven it did not require looking at to see if everything was satisfactory. Why, then, were glass doors being fitted to some cookers to save opening the doors? Those who had taken the trouble to learn to cook in an uncontrolled oven could, and did, turn out meals excellently and consistently cooked. Mr. Tarrant suggested that these thermostats were only a complication except in the cases when the consumer merely set the dial at the required setting, put the meal into the oven, and did not endeavour to ascertain whether better results could be obtained by varying the setting. He would also like to see the hotplate more simply constructed—eliminating all corners where grease could collect.

The cooker was quite a simple appliance compared with some of the modern types of water heater. Great ingenuity was shown in the case of the single-point water heater in order to ensure that the gas could not be on unless water was passing through the apparatus. In the past this had been effected by interlocking taps—a most simple arrangement, the only danger lying in the failure of the water supply, which was a most unusual occurrence. Now there were various systems on the market—bucket valves and valves operated in other ways by the flow of water. Consequently a simple appliance had developed into a complicated machine. In regard to multi-point water heaters, one was continually hearing of new models being put on to the market, each more complicated than its predecessor. He would not attempt to go into all the details of construction, but merely questioned whether all these delicate parts were necessary. He admitted that they were advantageous in the case of prepayment installations; but if the heater was such a potential source of danger without a cut-out, surely a great risk was being run with many heaters now on the district. These modern safety devices, said Mr. Tarrant, placed people under a false sense of security. In the old days—when caution cards were included with the appliances—the consumer relied upon his own initiative and on the instructions set out on the card. The danger of doing this or failing to do that was forcibly impressed upon him. Now he relied on mechanical means to overcome the latent dangers of various gas appliances.

Mechanism too Sensitive.

The mechanism of gas appliances had become very sensitive—so sensitive, in fact, that the smallest piece of dirt or grit was liable to upset the operation. Consequently the valves had to be dismantled and cleaned, which in itself was more difficult than before, and he was sure the fitters concerned had many anxious moments. All that the consumer was concerned with was the obtaining of a liberal supply of hot water—not with various compensating devices to ensure that the temperature of the water did not vary a few degrees above or below a predetermined figure.

In regard to gas fires, they themselves had not become too complicated, with the exception of the various lighting devices. But there was one point he would mention, and that was the multitude of types of radiant on the market, each type more efficient than its predecessors. If this was so, then why were the less efficient types still being made and fitted to fires. It only complicated store-keeping.

Mr. Tarrant went on to mention lighting devices for various appliances. These ignition devices—with their pilot which lighted another pilot which in turn lighted the gas—whether operated by battery or flint and steel, were liable to go wrong. They were, to his mind, an unnecessary complication unless they could be made positive. When a consumer's lighter failed to function he always overlooked the number of times it had worked and felt very annoyed—immediately 'phoning his gas undertaking and asking for it to be put right. This point of customer irritation was very important, and even though it might only be a small matter that had gone wrong it condemned the appliance in their eyes. Gas undertakings had spent a great deal of time and trouble in bringing their service to such a state as to eliminate this irritation; now they were supplying appliances which tended to increase it, a matter which could not be countenanced in the face of present competition. The failure of a gadget might even lead to the gas appliance not being used at all.

The question of maintenance was extremely important, for all these gadgets required intensive and more frequent maintenance; and more often than not attention was required between the usual periods of inspection. Moreover, the actual cleaning of the appliances took longer on account of the complications—more tools were needed; more parts had to be taken round to replace faulty ones—consequently more numerous stores items. All these things tended to increase maintenance costs, particularly in respect of appliances on instalment purchase. Again, one could not expect a fitter to collect a new type of appliance from the stores and then go and fit it correctly on the district. He required to be instructed in regard to the construction, fixing, and maintenance, which meant that special lectures had to be given. These were expensive and a needless waste of time. He did not mean that the fitters did not require tuition; but it was a waste of time on account of the unnecessary complications of construction.

The increased cost of these gadgets was another point which must not be overlooked, for if appliances were produced with the addition of these gadgets at the same cost, surely it was fair to assume that without them they might be materially reduced in price. In conclusion, Mr. Tarrant suggested that there was too great a tendency in modern appliances towards mechanical means of operation. People relied too much on these mechanical devices and consequently failed to understand the fundamental principles underlying the construction.

For the Opposition.

Mr. R. N. LEFEVRE (Gas Light and Coke Company), in opening the case for the opposition, said that if they traced the history of industrial development in this country they would find that practically all the convenience they enjoyed to-day had come to pass in the last century. Twenty-five years ago many so-called modern inventions were an established fact, and it was true to say that since then no startling discoveries had been made. And yet the last quarter of a century had wit-

nessed more scientific research work than, perhaps, had occurred during the whole of the world's history previously. What then had happened in the last 25 years?

If they examined their own Industry they found that, in 1911, the gas cooker, the water heater, both instantaneous and storage types, the gas fire, and radiator—in fact, all appliances known to-day except the refrigerator—were in use. But compare the appliances in use then with the gas appliances of to-day! Efficiency, appearance, performance, utility, reliability, and safety had each been taken into account in order to produce the wonderful appliances which they now offered to the public. Could they now sit back and rest on their laurels? Many thought that they should.

But what of their rivals, asked Mr. LeFevre. They too were improving every day, and if the Gas Industry were to continue to increase their sale of appliances and, in turn, their output of gas they must undoubtedly attract the public by offering every possible idea which went one better than either their rivals or themselves. There was no doubt that the public to-day loved gadgets. The very word "automatic" had a fascination for most people. The modern gas fire with its automatic lighter, the multi-point water heater with its automatic valve, the room thermostat, and the like had all caught the public imagination and done much to enhance the prestige of their Industry.

The public certainly did not think the modern gas appliance was too complicated. Who then did? Apart from his learned friend, Mr. Tarrant, he ventured to suggest that no one did. The two people most interested in the complications or otherwise were the gas fitter who installed and serviced it and the person who used it. Mr. LeFevre observed that he spent the greater part of his life imparting knowledge to the personnel of the Gas Industry. On account of their efforts in recent years he was a very different man to what he used to be. The modern gas fitter—or gas appliance mechanic, as he ought to be called—was well trained to appreciate the advantages of mechanical and automatic devices. He could fit them and adjust them with confidence. That he did understand them was borne out by the number of suggestions for improvements or for new devices which were constantly being received from the fitting staff. That there was a limit to complication and gadgetry no one would deny. There was no point in introducing unnecessary complicated devices just for the sake of doing so. He knew of no instance, however, of this being done. A device was only added to a gas appliance after it had been shown that a need existed for it and after exhaustive trials of its utility and merit had been made.

Ignition Devices.

Mr. R. F. HAYMAN (Gas Light and Coke Company) said that the development of the modern gas appliance had been stimulated particularly during the last few years by intensive electrical competition. One chief advantage of electric appliances was the ease of switching on or off. This was particularly apparent with lighting fittings. It followed, therefore, that similar ease of control had to be embodied in gas appliances if the public were to receive equal facilities for bringing into operation and shutting down appliances. The instruments necessary in this respect were ignition devices. In the case of one well-known system the use of several feet of cable terminating in a wall switch and a gas valve respectively could not be condemned as a complication when one considered the obvious advantage of being able to light an appliance by depressing the switch. After all, the principle of operation was very little different from the brake of a bicycle, and he maintained its use was just as essential. Even so it would be said that such an attachment applied to lighting fittings or gas appliances in general did not make for simplicity or attraction. That, Mr. Hayman suggested, could be countered by development work of similar nature to that being pursued in the laboratories of his Company on cold catalytic ignition. The fitting of a flint or other type of automatic lighter to cookers made lighting the several burners almost a joy; particularly the less accessible oven burners.

There were quite a few types of lighter available, all of which would be improved with increasing experience, and all of which helped to diminish the use of the matchbox.

An important trend these days lay in the ever-increasing use of continuously operated appliances such as storage heaters and refrigerators. All would agree on the value of such appliances, but it must be emphasized that such appliances needed some factor of safety. This was usually fitted in the form of a thermo cut-off, thermostat, &c., complications which made for smooth and efficient running. It was very necessary that the two examples cited—*e.g.*, storage heaters and refrigerators—should not be allowed to operate in the event of a pilot failure or similar happening.

Again, it was equally essential that instantaneous water heaters should not be lighted either when empty of water or full of gas. This was prevented by a safety cut-off similar to the one already mentioned or else by an interlocking gas-water valve.

With reference to the fact that Caution Cards were displayed, why remind the public of potential danger? It was far better to get a device which would do the work quietly. All these complications were thus an important part of the appliance, and it was of interest to note that by far the greater proportion of accidents arising through the use of gas appliances had proved to be on apparatus either not coming up to gas company standards or else not fitted with safety devices. This in itself offered some considerable evidence for continuing to adopt these extra safeguards.

Another important addition to gas appliances in recent years, continued Mr. Hayman, was the thermostat for automatic temperature control. He thought the day was past when the cooker thermostat was regarded as a toy with an attractive coloured knob to twiddle, but it was not generally appreciated that it was a scientific instrument. It was really remarkable that such an instrument which was turned out very cheaply, on large scale mass production lines, was in the vast majority of cases extremely reliable and moreover accurate to within a few degrees. The advantages of a thermostat fitted to a cooker were well known, but perhaps he might stress the advantage to the consumer of economy. Again the addition of a thermostat to a water heater would ensure the temperature of the water being kept within any desired limits, and this was particularly important when it was remembered that the formation of scale rapidly increased at temperatures above 140° F. Thus the control of water to this or a lower temperature was an example of an additional device reducing maintenance costs and at the same time preventing ultimate loss of efficiency. A further most useful general control fitted to appliances was the governor. This so-called complication was of considerable value in general design in that the overload gas rate figure could be cut down and the area of the appliance correspondingly reduced. This clearly enabled an appliance to be designed on smaller and cleaner lines. Again, of particular application to cookers was the use of a governor in conjunction with fixed injectors. Here was another case of an additional fitting resulting in simplification, because the normal injector with pin control and air adjusting screw could be replaced by a simple fixed injector, which could be made more cheaply and with greater precision than the adjustable type.

The Meaning of the Word.

Mr. L. H. PINKESS (Gas Light and Coke Company) enquired what was meant when they spoke of "complications." The word as used from the point of view of the consumer on the district had not the same meaning as the word used from the manufacturer's point of view or the designer's. Most of Mr. Tarrant's arguments had been based on the failure of various appliances—in fact, he had directed his criticism either against teething troubles or bad design. It must, however, be remembered that they were only just beginning to apply automatic control to gas apparatus in the place of elaborate warning and instruction cards which were admittedly more complicated. Apart from these teething troubles, modern gas appliances were simple. The domestic fitting staff must, of course, have more training, but apart from the good effect of this upon the men's minds, it was of definite advantage to the gas undertaking. For the fitter was the man who came most in contact with the consumer, and a well-educated fitter was a good salesman. Mr. Tarrant had mentioned that a great deal of annoyance was caused when things went wrong. The designer must not be afraid of complications, because the successful operation of the appliances depended upon them. The annoyances were caused in large measure by poor design and hastily put-up jobs by people who had not really given thought to them. They could not stop progress, said Mr. Pinkess, and as manufacturing methods improved they would be able to utilize more and more complicated appliances; they must either go forward or back. On the other hand, he admitted that complications could be carried too far; one must balance up the design against manufacturing methods. He sympathized with Mr. Tarrant in regard to the thermo cut-off; the number of accidents which did occur was, relatively speaking, very small, and it might appear open to question whether it was worth while putting thermo cut-offs on some appliances.

Mr. E. J. WARREN (Wandsworth) observed that the opposition seemed to suggest that the modern gas appliance must needs be complicated in order to work efficiently.

A Necessity of Modern Life.

Mr. F. O. HAWES (Tottenham) refuted Mr. Tarrant's suggestion that automatic oven control was pandering to the lazy person; it was, he observed, a necessity of modern life. In the generation before their own it was the practice for girls to learn housewifery before acquiring a home of their own; but to-day girls went to business and had very little experience of cookery. The oven control was therefore a good selling point. Again, the gas lighting switch was not merely a convenience, but was definitely the thin end of the wedge in keeping out electric lighting. One could, however, go too far with unnecessary complications.

Mr. F. H. HIGTON (Dorking) observed that Mr. LeFevre had drawn attention to the Gas Light and Coke Company's excellent training scheme; but, he remarked, there was still a part of the country which was not under the control of the Gas Light and Coke Company! He suggested that the Industry could give excellent service without becoming too complicated. Many of the gadgets being supplied to-day were too fragile. They should not fit something merely because it was a gadget.

The opinion was expressed by another member that the "gadget" should be regarded as part and parcel of the appliance, and in this capacity they were persuading the public to buy appliances. The adherence to "complications" of Watson House, to a man, was made clear by a speaker's suggestion that if appliances were generally simpler there might be a good deal of unemployment in that quarter!

Mr. R. SUMMERSON (Luton) remarked that the chief objection to automatic gadgets was that they were liable to go wrong, so

that without efficient service one would have consumers grousing. And they would not always grouse to the gas undertaking; one should hear neighbours talking to one another! It was pointed out by Mr. F. HOLLAND (North Middlesex) that much of the trouble was due to gadgets being put on the market before they were perfected, with the result that they were continually being altered. A final speaker observed that in his opinion the term "gadget" was a wrong one, and that the opposition were doing themselves no good by using the word. The modern gas appliance, he suggested, had no such thing as a "gadget" on it. These things did work, and worked well. A "gadget" was something that one "fiddled about with," and to use the word in connection with gas appliances was, he considered, wrong.

This concluded the first debate, and on a show of hands the original motion was lost.

(2) *In the Opinion of this Meeting*

THE GAS INDUSTRY SHOULD SELL GAS ONLY.

Mr. W. R. BRANSON (Gas Light and Coke Company), introducing the case in support of the motion, said that it should first be explained that attention had been confined to gas and coke, since coke was the only by-product likely to come into direct competition with gas and because at the present time coke made the most important contribution to the total income from residuals. Granted that coke yielded a net revenue of approximately 1·5d. per therm of gas made, it must be remembered that the charges against coke did not usually include any contribution towards the capital cost of works plant. The cost of coke handling, storage, and loading plant, including the value of land used for storage, represented a considerable part of the total cost of works though it was difficult to arrive at an accurate figure. Even if a deduction be made for capital charges, however, the return from coke played so important a part in reducing the cost of gas manufacture that he was in complete agreement with those taking the opposite side in the discussion when they said that the selling of coke should receive more rather than less attention. In the next few minutes he wanted to convince them that in many cases coke was competing with gas, and that this additional attention to coke sales should be concentrated on the development of coke markets where this competition would be a minimum.

The cost of graded coke per therm in London, said Mr. Branson, was in the neighbourhood of 1·8d. (equivalent to 43s. per ton of 290 therms). If the efficiency of a gas fire was only double that of a coke fire, it would be seen that gas at 3·6d. per therm was as cheap as coke for space heating. In fact, due to the ability to turn off the gas fire when not required and the consequent savings, the relative overall efficiencies were probably as 3 is to 1, in which case gas at 5·4d. would be as cheap as coke. In his opinion, a properly lagged system of water heating by gas would be twice as efficient as the normal arrangement of coke boiler with unlagged tank. The useful heat provided by radiation losses from the coke boiler could be supplied by means of flueless gas heaters with an efficiency of 100% and would be readily controllable. Hence it might be said that gas at 3·6d. per therm was roughly as cheap as coke for water heating in small houses. With a better load factor and thermostatic control coke would appear in a more favourable light. So far fuel costs only had been considered, and even here it would seem that where gas could be sold at 4d. per therm, costs would be little if any greater than with coke. At the present time domestic labour in this country was largely unpaid; but, looking into the future, one could foresee a time when the housewife would demand increased leisure, and when hired domestic labour became both dearer and more scarce, the labour-saving advantages of gas over any solid fuel should then result in greatly increased consumption. For these reasons Mr. Branson believed that the most urgent problem of the Gas Industry to-day was the evolution of an economic complete gasification process, capable of making gas of high quality. Present processes of this type had not proved attractive to any but a few of the smaller undertakings. High-pressure technique was still in its infancy, but knowledge on the subject was accumulating at a rapid rate, and it was in this direction that a suitable process might be found.

The gasification of coal and coke by means of oxygen was at present the subject of research by the Institution's staff. The use of oxygen at either high or low pressures combined with the syntheses of CH_4 from the CO/H_2 mixture made possible the production of a high calorific value gas by a continuous method. If successfully developed such processes might operate on relatively cheap coals, and in the case of high-pressure plants these might be situated at the pit-head. A plant of this type was already in operation in Germany. The use of high pressures involved considerable cost for compression, but the enormous saving in volume of plant required for manufacture and purification might effect a revolution in the appearance of the gas-works of the future. In addition, it would be possible to transmit large volumes of gas over considerable distances economically once the compression costs were accepted as part of the cost of generation.

Reduction in the price of gas depended as much upon economies in distribution as on cheaper production methods. It would be generally agreed that large savings in distribution costs were only possible if the consumption per consumer could be greatly increased. Such an increase as would be obtained if gas became the normal method for heating the living rooms and providing the hot water in the homes of their millions of consumers would result in enormous economies in distribution charges.

He had attempted to prove that while coke must be sold at the best possible price, every effort should be made to direct its sales into channels where it was not competitive with gas, and at the same time research should be directed to the possibilities of other processes of gas manufacture so that the Industry might eventually be freed from the difficulties due to selling competing products and be able to devote its entire energies to the sale of a product possessing manifold advantages and free to a great extent from the repercussions of trade cycles in other industries which rendered the solid fuel market liable to fluctuations outside this Industry's control.

The Case for Gas and By-Products.

Mr. J. GRAYSTON (Lea Bridge), opposing the motion, remarked that in introducing what for want of a better title he would describe as a "Co-ordinated Fuel Sales Policy" for the Gas Industry, he would suggest that there was one fundamental which must never escape their attention. It was the bare fact that in all processes of gas manufacture which had proved an economic success over an extended period, the production of by-products was a very necessary corollary; they could not make coal gas in any retorting system without making coke, tar, benzole, and ammonia. The inability of any system of complete gasification to justify its continuance on both practical and economic grounds, was, to his mind, an unerring tribute to the importance of residuals in a gas-works revenue account and one which immediately prompted the thought that were it not for the income derived from residuals they would not be in a position to sell gas as cheaply as they were doing to-day. There existed a very wide market which if they did not enter through the avenue of coke, they would not enter at all.

He was going to suggest that the ideal they ought to aim to achieve was to sell the entire coke production of the Industry in the purely domestic field—undoubtedly their most remunerative market. Those who had seen the Bradfield analyses of Accounts for the nine Metropolitan Companies for 1935 [see "GAS JOURNAL" for March 11, 1936] would have noticed that the net receipts from coke varied between 21s. and 24s. per ton, which in the case of the lowest, the Gas Light, was an advance of 1s. 7d. per ton over the 1934 receipts. Expressed as revenue in pence per therm of gas sold, the income from coke was increased from 1·55 to 2·16 pence per therm; this in itself was no mean contribution to the expansion of gas sales, for he imagined that gas at 1½d.-2d. per therm higher than present prices would not be very encouraging to their gas salesmen, nor attractive to present consumers, nor productive of additional business. This was a telling argument in favour of a dual fuel policy which he must emphasize at this stage, but did not constitute the whole of the point he raised earlier—namely, that all coke should be sold in the domestic market. The schedule prices for coke sold on domestic contracts were nearer 40s. per ton, and after allowing for expenses would probably realize 10s. per ton more than their present average net receipts. A rough arithmetical proportion which he thought it was permissible to apply showed that by this means the basic price of all gas could be reduced by at least ½d., or in most cases nearly ¾d. per therm. If those salesmen among them did not think this would be a sales asset, then devote the surplus revenue to making more attractive their block or two-part tariffs. This was the first way in which domestic coke sales could help with gas sales; they offered the most ready and flexible means towards the reduction of their main commodity price.

An examination of all heating problems revealed a state of affairs which compelled them to regard gas and coke as the ideal and inevitable complementary fuels. There was in every instance a base load and a peak load of artificial heat requirement. In the humble cottage dwelling there was a living room where the family required a fire from 12 to 16 hours a day for eight months of the year; there were also occasional rooms where artificial heat was required at perhaps fairly frequent intervals of short duration. The first of these was their base load—to his mind definitely a coke demand, because no matter on what form of tariff they offered their gas, the average artisan dweller could not afford to burn gas continuously throughout the whole winter. The base load was in the majority of cases held by coal, and it was coal which their coke fires were going to oust; they were competing in a field which by sheer force of economic circumstances was not open to gas. This they were doing successfully and showing a saving of anything up to 2s. a week as compared with coal. The occasional load, however, belonged to gas, and it largely lay within the province of their gas salesmen to convince the general public that this peak load was a definite reality. Once they had shown the consumers a financial saving by means of coke on the base heating load they would be all the more ready to increase their intermittent demand for gas.

What was true of the ordinary cottage dwelling was equally applicable to the large residences, villas, and blocks of flats. Here the base heating load was a case for central heating; oil was their competitor and one not easily met by gas excepting at

very unremunerative prices; the gravity-feed coke boiler had captured this field for coke for all time, possessing all the advantages of oil firing at only half the price. This left a clear opening for gas in the field of occasional heating which, he thought, they could better approach when they held the base heating load with coke. The application of coke for central heating by means of the gravity-feed boiler had opened up a new avenue of business for gas undertakings. He referred to the "all-in" heating contract, whereby the gas undertaking provided the entire heating and service requirements of an institution or factory, for a fixed sum per annum, independent of fuel consumption.

Mr. Grayston had endeavoured to show that there existed many unexplored gas loads which could be built up on the correct marketing of coke. It still remained to be decided as to whether these coke sales were ever in competition with, or detrimental to, gas sales. Last year over 70,000 coke grates were sold in the area of the London and Counties Coke Association and the whole of these sales had been very carefully analysed; it was found that in only 6% of these had gas been given any consideration as an alternative while in the remaining 94% gas had not even been considered; the gain was entirely from coal and was not detrimental to gas sales, for the gains were in a market in which gas was not even a competitor. A point to bear in mind also was that every coke grate had gas burner ignition with an annual consumption of about 3,000 cu.ft.; if any undertaking could sell just one open coke fire to every domestic consumer this consumption would represent an increase in gas output varying between 12 and 16%.

The other province in which gas and coke were both prepared to fulfil the same demand was that of domestic hot water. For those who could afford it, by all means fulfil their demands by gas, the ideal fuel for constant hot water service; but he suggested there were millions of homes in this country to-day where the total family income did not permit of this service on account of cost. To them the domestic coke boiler was a boon and a blessing and would give them all their hot water and in the winter quite a lot of heat for clothes airing and so on for about 1s. a week. While coke might form the fuel for the foundation of domestic hot water service, it was performing yeoman service to the cause of gas by educating the public to the idea of hot water on tap, and before long they found they wanted hot water without the trouble of keeping the boiler alight all night, or without discomfort in the summer time, or for occasional use at the sink. Therefore they installed a multi-point or some other form of gas water heater to operate in parallel with a coke boiler, and so did coke open up the application of gas to water heating in literally thousands of houses where gas could not enter alone.

Economic Utilization of Materials.

Mr. W. T. FARRANT (Croydon) said that the cost of raw materials—coal, coke, oil, &c.—made up approximately 50% of the total charges of gas manufacture. This being so—and he thought their present policy led them to produce the cheapest possible gas—it behoved them to utilize those materials in such a way and in such proportions as to give them this result. The fluctuation in the prices of materials and also in residual products had to be watched, apart from constants such as wages and wear and tear; and money could be wasted in a very short period through uneconomical utilization of their raw materials in the manufacture of mixed gas instead of in fulfilling the demand for residual products. For guidance in this direction he would like to refer to their President's Address in which Mr. Webber had stressed the importance of developing a costing system to enable them to keep before them a comparative statement of expenses and returns in respect of residual products. In relation to this item they must look to the future prospects of coal.

Coke was becoming more useful in reducing the cost of making gas. On referring to the Croydon figures, he saw that the percentage of revenue from coke in relation to the total revenue—which showed very little variation over a period of years—was equal to about 16. This figure did not give any account of the cases where they had lost gas to coke; but it certainly indicated that they were maintaining their revenue from coke either by better prices or increasing yields. The question whether the increased use of coke in recent years had had any detrimental effect upon their revenue from gas was extremely difficult to prove; but he would prefer to think that the reason that coke was holding its own so readily was entirely due to the public wanting a cheap form of heat. Indeed, when they put it in terms of heat value it would be found that they were selling more therms in the form of coke than in the form of gas. But the most they could get for coke was 35s. per ton, which was equal to about 1¼d. per therm. Yet much more money was being spent on cleaning and preparing the fuel. But they were faced with their balance-sheet each year, and he thought that this must determine to a large extent any alteration in their methods of production both of gas and residuals. He considered that this question of raw materials, and the way they utilized them in making provision for any residuals that were remunerative, could be a great saving or waste according to the way they were dealt with.

Let them assume that in the future the public would gradually drop solid fuel; they would then be faced with the problem of turning the whole of their residual coke into gas, and it would have to be turned into gas at a price reasonable enough to meet the requirements of their districts. In 1932 they prepared an investigation on this subject, and they came to the conclusion that they could, with the price of their materials ruling at that time, utilize in the water gas plant such quantities of coke as they made and still be in a position to manufacture a mixture as cheaply. The interesting point was that they found that the whole of their coke could be utilized with a mixture of 70% carburetted water gas and 30% coal gas.

Complete Gasification.

Mr. C. A. DEAS (Hertford) remarked that he did not think Mr. Branson had convinced them all that they would have to look to gas only in the future. The biggest problem was to discover a plant that was going completely to gasify coal economically. Unless they were prepared to alter the size of all their mains and holders they must enrich the gas from such a plant. The only way they could do that was to use gas oil, which was perfectly economical for the peak load, but when they used it for the base load it would certainly affect the balance-sheet. Even if they could utilize gas oil economically, they would be dependent for 30% of their gaseous therms upon an imported product. Another point was that the average Englishman still liked the open fire, and if he liked it they must give it to him. So why not sell him coke for it? Again, modern coke-burning appliances were becoming automatic, and their efficiency was somewhat higher than Mr. Branson had led them to suppose. One could lag a coke boiler as well as a gas boiler. The present price of gas was not competitive with coal or even oil, and Mr. Deas did not think there was any prospect of effecting any material reduction in that price. Some people said that if they could sell more gas it would become cheaper. But Mr. Deas questioned whether this really was so. Works costs were as low as they were ever likely to be; and, furthermore, the more gas they sold, the more service they must provide. The important point was the ever-growing return from residuals; an analysis of their accounts showed that residuals were bringing in more and more, and he estimated that at the present time they accounted for something like 60% of the cost of raw materials. Again, in the small houses which were being put up in such great numbers to-day, coke was required in smaller deliveries owing to the lack of storage space—which increased the overhead charges. The future of the Industry depended upon their taking a ton of coal and getting the maximum out of it. If the public wanted a solid fuel they must be prepared, as a fuel industry, to supply it; similarly, if the public required motor spirit, they must supply it in the form of benzole.

Mr. F. O. HAWES remarked that Mr. Deas had stated that they could lag a coke system, and in his opinion Mr. Branson was unfair in comparing a lagged tank with an unlagged one. He considered that 4d. per therm was out of the question for the masses of the people; therefore they must provide the solid fuel load which the public wanted. Gas could not obtain this load, and so coke should take it. Not long ago—before the London and Counties Coke Association came into existence—the Chairman of one gas company stated that the trading profit on gas was *nil;* they were making all their profit on appliances. Every undertaking did not do that; the present coke position had reversed the conditions, and with the reduction in the net profit on coal the profit was now coming from the whole business of the undertaking. They were a carbonizing industry, and they must carbonize in the most profitable manner having regard to the circumstances ruling at the time.

Another speaker emphasized that coke was the only fuel they could put up against oil competition. If they went all out to sell gas for the domestic load they could use coke better in the larger installations.

Mr. R. SUMMERSON (Luton) remarked that if the Industry was to maintain its present output by selling gas to the heavier industries at 4d. per therm, the poor man had to pay the full price. If in the future industries became less prosperous they would have to provide them with gas at a still lower figure. There was another reason why he was sorry that the coke business had not come to the fore earlier than it had—namely, that if coke had got into the modern houses sooner and had secured the base load they would have appliances in those houses fitted with flues. Furthermore, all gas appliances were tested and approved by interested people, such as the makers; but coke appliances were tested by an independent central body, the London and Counties Coke Association, which was all to the good. Mr. Summerson considered that the gas side should follow suit. In conclusion, he stated that until they could sell gas much more cheaply they must go on selling coke.

Mr. H. MOYS (Croydon) spoke of the advantages of the water gas plant, particularly in reference to the rapidity with which it could be shut down and started up again. In addition the amount of labour required was extremely small, while little heavy work was needed on a modern automatically controlled plant.

Mr. BRANSON, commenting upon some of the points raised, said that if they continued to sell coke he was positive that in ten years' time the gas load would go down. Also the price looked like going up unless they could obtain a big load factor. They could not make more than a fraction of the coke required to supply the domestic load unless they sold more gas. It was time they investigated a new process for producing high quality gas such as was being done on the Continent. In conclusion, he observed that if one lagged a coke boiler system it boiled the whole time.

The meeting terminated with a hearty vote of thanks to the respective proposers and opposers of the motions on the proposition of Mr. SUMMERSON, seconded by Mr. P. F. SCARTH (Gas Light and Coke Company).

NOTES ON THE

Removal of Water Vapour and Naphthalene from Town Gas

by
D. J. HEYCOCK,
of Port Talbot.

From a Paper presented to members of the Wales and Monmouthshire Junior Gas Association at a meeting held at Port Talbot on Saturday, February 15.

At Port Talbot considerable difficulty had been experienced, due to interruptions in the supply of gas to consumers. These were due to the crystallization of naphthalene in service pipes, and obstructions caused by rust formation which had accumulated over a period of years. Apart from the cost of dealing with the troubles experienced, it was considered that anything that could be done to improve the service to consumers would be worth while.

It was decided to install Holmes "Multifilm" washers for the removal of naphthalene and the reduction of water vapour in the town gas.

The entire elimination, or at least a considerable reduction, in the replacements of gas service pipes is of great importance to the Gas Industry. The breaking up and restoration of road surfaces is expensive. With the distribution of dry gas and suitable exterior protection, the life of service pipes should be indefinite. In some cases larger pipes are laid than are necessary; in others, heavy gauge pipe is used to delay the final perforation. These precautions become unnecessary with dry gas. Again, there will be no necessity for the utilization of expensive wrought-iron in place of steel.

It is always possible that mains and services may have sunk out of their original level, or they may have been laid badly. In consequence they become partially choked with water. A dry gas passing through such mains and services would remove the condensate, restoring the original carrying capacity.

Fears were expressed that the dehydration of coal gas would have a deleterious effect on the leathers of dry gas meters. It was advocated that they would dry up, with resultant cracking. Exhaustive tests have been carried out, and it has been proved that the dried gas has no mal-effects. The partial drying of the gas does not remove the oil vapours. When a meter is operated by a dried gas, rich in hydrocarbons, it is working under ideal conditions for longevity.

The dehydration of gas prevents the corrosion of the division plates and gasways in meters. Dehydration also reduces rust deposits on valves and seatings.

Water vapour is an inert gas. Its removal decreases the volume of town gas by something like 1 to 2%. The calorific value increases proportionately.

The tar-sealed or dry holder is, in some cases, utilized for the storage of town gas. The dehydration of the gas assists in the working of this type of holder. A condition for the efficient working of one type of gasholder is the provision of a water-free tar as a sealing medium. If water is allowed to condense out in the holder, it inevitably mixes with the tar seal. In winter time, if water is present in the circulating fluid, there is a danger of it freezing on the walls of the holder, thus upsetting the even working of the disc. In addition, there is the difficulty of maintaining the seal in such circumstances; when condensed water emulsifies with the tar, the resulting mixture does not form a good sealing medium.

Experience has demonstrated that stoppages due to the formation of ice in exposed services and meters can be eliminated by the distribution of dry gas. The failure of street lamps, due to frost stoppages in the standards, can be ascribed primarily to the fact that average ground temperatures in winter are above the average temperature of the atmosphere, so that deposits of water in the underground mains yield supplies of water vapour to the gas, which are condensed and then frozen in the exposed standpipes.

Dehydration helps in the detection of gas leakages. When there is a leak of dehydrated gas, the earth immediately around the escape rapidly becomes dried, becoming powdery and easily worked away.

We work the calcium chloride solution at concentrations of 74, 77, 79-80, and 77° Twaddell for the winter, spring, summer, and autumn seasons respectively. Of course, the concentration would be rectified at any time, to suit any unusual temperature. Twaddell readings are corrected to 60° F. as follows—for every 8° F. below 60° F. we subtract ½° Tw. from the reading, and for every 8° F. above 60° F. we add ½° Tw.

Reasons for Selection of "Multifilm" Plant.

(1) There is no wearing of the brushes. Thus the brushwork has an indefinite life, as it is non-metallic, and unaffected in any way by gas, oil, or chloride.

(2) This type of washer is of the lightest construction, there being a definite saving in the cost of foundation work.

(3) Increased contact between washing medium and gas is possible.

(4) It is easier to extend a static washer to meet increased gas requirements.

(5) The initial cost of a "Multifilm" washer is less than that of a rotary washer of equal capacity.

(6) All moving parts are external to the plant.

(7) The sprays are easily cleaned by an externally operated cleaning tongue, and moreover are visible in operation through large inspection windows.

(8) The construction of this washer is such that very little back-pressure is thrown by it. The maximum back-pressure at Port Talbot is 3/10 of an inch, with a gas rate of 33,000 cu.ft. per hour, though it must be borne in mind, in this respect, that the plant was originally designed for a gas rate of 1,500,000 cu.ft. per diem.

The fact that there is also a slight saving in steam consumption with the "Multifilm" washer was also taken into account. We have a 2 h.p. turbine installed for pumping oil to the naphthalene section. On the 6 ft. six-bay rotary washer, which is the equivalent, a 3 h.p. engine is generally installed.

The plant is practically "fool-proof" and simple in operation. The main precaution necessary is to avoid over-concentration of the chloride solution. Ammonia in gas is rarely encountered after the oxide purifiers, but if it is carried forward to the washer, calcium carbonate will be formed, together with ammonium chloride. The latter dissociates in the evaporator and the consequent slightly acid solution would correct itself by decomposing the calcium carbonate formed. We intentionally allow a little ammonia to go forward to the purifiers; nevertheless the deposition of the carbonate has been negligible. A scale resembling rust and containing some calcium carbonate forms on the evaporator; but this is easily removed and its growth is slow.

Since the end of September, 1935, no condensate has accumulated in the syphon pots on the district, and they have all been "blowing" gas.

Fouling of Gas from Chloride.

The "Dri-gas" plant had been in operation for some months, when trouble was experienced, due to the presence of small quantities of sulphuretted hydrogen in the gas entering and leaving the holder. This was found to continue, even when two purifier boxes and the catch-boxes gave "clean" gas.

Methodically, by the process of elimination, the cause of the trouble was ascertained. During the daytime it was found that the gas leaving the meter was clean, yet that leaving the holder showed foul. Suspicion fell on the gasholder.

The introduction of the process of naphthalene removal can bring troubles in its train, similar to the one quoted. Gas which is quite free from hydrogen sulphide at the inlet to the gasholder begins to show traces of the impurity at the outlet. It is found that the presence of sulphuretted hydrogen is due to the reduction of sulphates present in the tank water by bacteria, which cannot exist when naphthalene, present in the gas, is precipitated in the holder water. The naphthalene acts as a bactericide. If the sulphates are removed, the action ceases. They can be precipitated with barium chloride solution. Zinc acetate or a suspension of zinc oxide may also be added to the tank water,

so that any hydrogen sulphide which might be subsequently formed in the water is rendered innocuous by precipitation.

The naphthalene plant was put into operation at the same time as the "Dri-gas" plant. The fact that the holder tank had been filled with lake water (which is by no means pure) heightened our suspicions. Using the reagents iodine solution, cadmium acetate, and lead acetate solution, however, we found that the amount of hydrogen sulphide picked up over the holder was negligible.

Very soon we were encountering fouled gas leaving the "Multifilm" washer. Being unable to get conclusive information during the day, it was decided to make continuous tests all through the night with lead acetate papers to determine in which way the impurity got past the purifiers. (The specified official three minute test shows definite darkening of the lead acetate papers at a concentration of 0·1 gr. per 100 cu.ft.) These tests revealed that during the cold early hours of the morning, gusts of hydrogen sulphide were passing the boxes. Occasionally, the catch-boxes were found to be giving off traces of H_2S, although the gas entering the boxes was free from the impurity.

Again, any sulphuretted hydrogen given off from the liquor in the seal pots in the yard and openings in the well covers was absorbed by the calcium chloride passing over the evaporator, particularly as the bottom tubes were relatively cool. This action would occur during certain wind directions.

Any hydrogen sulphide passing momentarily through the purifiers, and coming from other sources, would be arrested in solution in the "Dri-gas" plant, and given off continuously from there until cleared out. It is probable that the acidic substances in solution then react slowly with the gas, giving off H_2S, for the sulphide is readily decomposed by acids.

The iodine tests (which were affected by the presence of unsaturated hydrocarbons in the gas) gave the most satisfactory results. Assuming that the gas entering the washer was free from H_2S (papers were not discoloured) the amount picked up through the washer was, in two instances 0·4 gr. per 100 cu.ft., though in the other case it reached 0·85 gr. per 100 cu.ft.

Iodine tests on the calcium chloride solution showed the presence of 0·49 to 0·56 gr. of H_2S per gallon (all oxidizable constituents calculated as H_2S), or 5·10 to 5·90 parts by weight per million.

The trouble had to be terminated quickly. The purifiers were watched very closely, and no H_2S was allowed at any time to go forward. Bleaching powder (domestic "chloride of lime" or "Chlorous") was added to the calcium chloride to oxidize the hydrogen sulphide which the latter contained. It is difficult to say whether this was of any value. Aeration of the return solution from the storage tank was considered, but this had the disadvantage that, by so doing, excessive absorption of moisture from the atmosphere would take place. On analysis of chloride solution, it was found that there was no free H_2S in the solution, that present being actually in the form of sulphide of iron. It is probable, therefore, that the H_2S which had existed in the solution had been either oxidized or converted into sulphide.

Eventually the sides and base of the evaporator were boarded around, and seal pots and liquor well openings were attended to, with a consequence that no further trouble has been experienced.

On many gas-works, the H_2S concentration in the air, in the vicinity of seal pots, and tar and liquor wells is much more than 0·1 gr. per 100 cu.ft.

The vaporizing of paraffin was employed at Port Talbot for six months before the "Multifilm" "Dri-gas" naphthalene washer was installed, and for three months after its installation. The object was to form a coating of oil on the inner surfaces of mains and services, particularly where the gas velocity was approaching a speed of 14 ft. per sec. The required object was achieved and no trouble from dry rust stoppages was experienced. The gas supply to the gas heated vaporizer was tapped off from the outlet of holder, before the station governor, thus giving a constant pressure of 9·2 in. W.G. which was always sufficient to overcome the back pressure from the district main.

Design of Naphthalene Plant.

The naphthalene plant is similar in construction to the "Dri-gas" washer, being of the "Multifilm" static type. With the "Dri-gas" washer, the washing medium is sent to the sprayers by a common pipe. The steam turbine supplying gas oil to the naphthalene section is so constructed (the turbine in effect driving a number of pumps on the same shaft and within the same pump casting) that each bay of the washer is supplied by a separate pipe. The naphthalene saturated gas-oil is tapped off from time to time (each day). It is not run back to storage from the common trough, of course, but to an overflow syphon, and the saturated gas-oil is mixed with tar and then run to the tar well.

In the naphthalene half of the washer, the naphthalene content of the gas was reduced from 4·3 gr./100 cu.ft. to 0·59 gr./100 cu.ft. A picric acid test is fixed constantly at the outlet of the plant. These tests run generally for a period of approximately three months, without sufficient naphthalene being taken from the gas to precipitate any naphthalene picrate.

The total inclusive cost of installing the complete "Dri-gas" and naphthalene plants was £1,650.

In considering the economies effected, it must be pointed out that prior to the installation of the plant, distribution complaints at Port Talbot were exceptionally numerous. These troubles were due to excessive internal corrosion that had proceeded rapidly over many years. The real source of the rapid corrosion was due to inefficient purification plant, high oxygen content, and distribution of gas with a high cyanogen figure.

The cost of attending to stopped services for the six months ended Dec. 31, 1934, including labour, materials, reinstatement was £1,070.

The cost of attending to stopped services for the six months ended Dec. 31, 1935, including labour, materials, reinstatement was £195.

These figures show the marked improvement that has been effected, and the great reduction in complaints means a very much better service to consumers.

The annual operating costs of the plant are as follows. The figures are, if anything, on the high side.

	£	s.	d.
Capital charges (20 years)	115	0	0
Labour	60	0	0
Steam and water	40	0	0
Gas oil (difference between buying and selling price)	33	0	0
Chloride replacement	16	0	0
Oil—lubricating	2	0	0
Total annual costs	£266	0	0

Meter repair costs are now commencing to show substantial reductions.

Discussion.

The PRESIDENT (Mr. J. F. Rust) suggested that the Paper would remove one or two old prejudices. Older engineers feared that dehydrated gas would tend to make meters read fast.

Mr. HEYCOCK said that the effect of dehydrated gas, in their own experience, had been, in one or two isolated instances, to make the affected meters register slightly fast. This was the case particularly where the meters had been previously operated under bad conditions with saturated gas. The oils present in the meter leathers could be removed by the water vapour present in gas, and subsequent dehydration of the gas would then dry up the meter leathers. The gas previously tended to keep the meter leathers supple. The meter leathers were, in consequence, liable to slight shrinkage.

Mr. D. E. WEST (Port Talbot) pointed out the freedom from worry through any possible failure to remove water from syphons, particularly at the inlet and outlet to gasholders. He also said that the particular plant could be cut off for close on three days, before the dew-point on the district became high enough to deposit moisture in the mains.

Mr. H. V. WILLIAMS (Cardiff) enquired whether oil was applied to the interior surface of service pipes, and, if so, what type of oil was used.

Mr. HEYCOCK replied that previously, at Port Talbot, they had utilized boiled linseed oil, but now the interior surfaces were painted with the best red lead paint. Only pipes of over 2 in. diameter were treated thus.

Mr. WILLIAMS enquired further whether they had experienced any escapes of gas from defective mains or services since the introduction of dehydration.

Mr. HEYCOCK said they had not.

Mr. SURTEES (Margam Steelworks) asked what oil was used for naphthalene washing.

Mr. HEYCOCK replied that gas oil was used.

Mr. I. G. JENKINS (Abertillery) proposed a vote of thanks to the Author, and this was seconded by Mr. J. H. CHAPMAN (Swansea).

Mr. E. M. EDWARDS (Port Talbot) said he was pleased to be able to compliment Mr. Heycock upon the hard work he had performed in the preparation of the Paper. It was not an easy matter for a young man to deliver his first Paper, and the initial step required courage. When possible, he continued, the "Dri-gas" plant should not be too close to the outlet from the purifiers, because in some instances the temperature of the gas leaving the purifiers was fairly high. It was an advantage for the gas entering the "Dri-gas" plant to be at as low a temperature as possible. Total meter repair costs, and meters registering slow, were being rapidly reduced. The number of meters showing a tendency to register fast was very few. When dry gas was first distributed main cocks should be kept under observation. In the case of main cocks that had been in use many years slight leakages developed due to the hardening of the deposit between plugs and seats. He said he was of the opinion that the reduction of water vapour in town gas was an essential feature of modern practice.

SCOTTISH JUNIOR GAS ASSOCIATION

At a meeting of the Association held in Glasgow on March 14.

Mr. David Fulton Addresses Members of the Western District

It is often said to me that I am fortunate in having control of an Undertaking in a residential community having a fairly large number of consumers well blessed with worldly possessions, and that we were lucky to escape electrical competition until so recently as 1927. That is one point of view, but, like everything else, it has its reverse side. People comfortably off are all very susceptible to the call of the fashionable mode of the moment, and to them electric light comes within that category of things, so that a large proportion of the larger houses have gradually adopted electricity for lighting.

The respect in which the delay in competition was undoubtedly beneficial was that we were enabled to build up a substantial consumer load before the attack. But because the attack was delayed it has been more intense and more concentrated than would have been the case had electricity been introduced earlier. The intensity of competition has, however, had the very beneficial effect of keeping us from complacency or inactivity, and new ideas and constantly changing methods have been developed to create effective resistance.

It is obvious that our lighting load, which was very substantial, was the first to feel the shock of competition. Good service in the past and good lighting were of no avail—electric light had to be substituted. Whatever view we may take as to the ultimate fate of gas lighting, my own opinion is that it is absolutely necessary to prevent anything in the nature of rapid surrender to the appeal of electricity. It is sound strategy to concentrate on the defence of the weaker positions, for a breach there must intensify the attack upon and danger to the stronger positions. The fight demands unremitting effort, and it is costly. Because of that some people think it is not worth while to spend money on the preservation of gas lighting and that the money spent in its defence would be better spent in developing new fields of use for gas. I join issue with such a view because there is really no field of use, particularly in the domestic domain, which gas can indisputably call its own. The attitude of the electrical people is that the lighting load is indisputably their own, and if we do not resist such claim, then electricity, having consolidated that position, will have forces released for the conquering of other fields.

Preservation of a lighting load demands a good maintenance scheme, and our first step towards that end was the substitution of regular and systematic maintenance and discontinuation of the policy of not intruding on the supposed domain of the master plumbers. Our maintenance service, which is entirely free, apart from the cost of materials supplied, works out at about one visit per consumer per annum, and has earned great goodwill and approbation. When a fitter can spend two days in one house overhauling lights and appliances, it will readily be understood that getting over a spread out area like ours seems a slow business, and the costs are high.

The first survey proved that while the very large majority of lighting fixtures were of good quality, they were of old-fashioned types, and there were large numbers of badly-positioned lights, particularly of the wall bracket type. Accordingly we were impressed with the fact that it is not enough to overhaul and adjust fittings so that they may give the best service of which they are capable; there must be created a desire for newer fashions and better gas lighting. The maintenance fitters were instructed to use all available opportunities of intelligently discussing modern gas lighting with consumers; a permanent canvasser salesman was appointed; our showrooms featured gas lighting by means of attractive displays of artistic and efficient fittings all lighted up at night and carrying price cards bearing the cost of the complete fittings in large figures. No direct charge was made for labour, fittings being supplied at list price. Easy payment terms were offered for fixtures and switches, and slot meter consumers have bought large numbers on the " pay through the meter " system. Newspaper advertising dealt with the high quality of good gas light, and leaflets of the personal letter type, which have dealt with the advantages of gas lighting, have been issued at intervals to consumers. The result has been that during the past two winters especially we have suffered embarrassment from the volume of business obtained and have had to engage additional fitters. The progressive nature of the business is illustrated by the figures for the past four years:

Year.	Burners.	Pendants.
1932	140	22
1933	224	35
1934	323	157
1935	536	287

The sale of switches has shown a steady, if somewhat slow, increase, and last year's number of 51 has already been exceeded in the current financial year. The sale of switches would be much greater but for the difficulty of hiding the cable. Consumers demur at the lifting of floors and at cable showing on walls; thus potential business is lost.

The success of our efforts is to be found in a still considerable lighting load, and many of our large residences remain satisfied with gas light. Nevertheless, we are forced to recognize that the mental attitude of the public generally is favourable to electric light. But resistance by consumers to the inducements of the electricity salesmen has been most encouraging to our efforts and creates confidence that we shall have a good lighting load for a long time to come.

Relations with Plumbers.

The activity described above in the sale and installation of lighting fixtures cut athwart the interests of the plumbing trade, and there was protest that we were exceeding our statutory powers as a Municipal Undertaking. But we held to our opinion that the circumstances demanded special treatment, and that any divorce of work from responsibility would prejudice efficiency. The Gas Department's vigorous campaigning could make available to the plumbers a certain amount of business in the way of maintaining and supplying lighting fittings, whereas the Department's abstention could only result in speedy transference of lighting business to electricity. The position is now accepted without rancour, and all signs of active opposition have disappeared. Indeed, we get a certain amount of lighting business from the plumbers.

Plumbers are allowed a substantial trade discount on all gas appliances, which assures them of reasonable profit and reward for their work in obtaining the business.

In the case of water heaters there is an agreement that whether the order is obtained by the Department or by the trade the water connections will be carried out completely by the trader, the Department attending only to the gas fitting of the appliances. The consumer is responsible for the plumber's account, but the appliance itself may be obtained on hire purchase terms. This arrangement has worked very satisfactorily, and we find the plumber recommending gas water heaters in opposition to electric immersion heaters. The co-operation so obtained without capitulation is very helpful to all parties.

Gas Appliances.

We cannot but recognize and appreciate the great service rendered to us by the manufacturers who place at our disposal efficient and attractive appliances. Necessity is the mother of invention, and the striking improvements due to vitreous enamel finishes and colour paint finishes coupled with increased efficiency and grace of line in design have helped enormously to maintain the prestige of gas for cooking and heating. I have, however, long held an opinion that too great freedom is given to individual tastes, resulting in far too many designs of cookers differing only in very slight degree, but the production of which panders to the vanity of buyers who wish their cookers to have the individual stamp of being a " Nirvana " cooker. This undoubtedly adds to the cost of the appliance. Improvement in this re-

spect must come from within the Industry; the manufacturers can hardly be expected to deal with it, as they are in business for profit and must meet the ideas of their buyers. But it is matter which ought to have the careful consideration of our National Bodies, and it should not be difficult to get the manufacturers to co-operate.

Admittedly, the standard cooker introduced some few years ago was less successful than its sponsors hoped—probably because it was more efficient than attractive in appearance. Strength as exemplified by weight is unnecessary, the life of cookers being governed by considerations of changes of fashion and forward steps in efficiency rather than by considerations of durability measured in decades. A cooker may be light but strong in construction and good for ten years, by which time, if experience means anything, it will be obsolete. Most of our stove makers are rightly proud of their foundries, and have a foundry complex which makes them antipathetic to other methods of manufacture. Nevertheless, I feel that we are moving slowly but steadily towards the development of stamped steel cookers.

Rapid changes have entailed a heavy burden of expense on gas undertakings faced with the need of replacing large numbers of black cookers; but it is a situation which must be faced, for every black cooker exchanged for an enamelled cooker, makes the consumer much less accessible to the blandishments of the electric cooker canvasser. I cannot deal with it at length, but the electric cooker is not our only competitor; the coal people have been active, and the very highly insulated multi-purpose coal cookers of which there are examples in our area are not to be despised or ignored. Attractive appearance and guaranteed fuel consumption are selling points of strong appeal. There can be no standing still, but a constant ambition to improve the gas cooker in every possible way.

Space heating, as gas fire heating is called in America, is exposed to particularly keen competition from electric radiators, full use being made of the low commodity rate without reference to the standing charge which is quietly allocated to the lighting account. The electric heater has undoubtedly very important advantages in respect of portability, and one radiator can therefore be used in one or more rooms only occasionally occupied. In its simple form it is also very cheap even if it is not durable. The competition certainly limits the scope for adding to gas fire business, partly as gas fires are so much dearer to buy than the electric radiator. In this matter it may yet be possible to produce a simple stamped fire approximating more closely to the price of its competitor.

It would be unfair to pass on without reference to the very creditable efforts made in various directions in the production of light portable gas fires, and sales of fires have greatly benefited by these additions to our stock-in-trade. Care should be taken that ventilation is good wherever they are used.

We have always been able to do a large business in gas fires, and even though in the last financial year we sold 136 fires and installed a further 64 on hire-purchase, we considered it wise to encourage owners of old black fires to scrap them in favour of up-to-date efficient coloured designs by reducing cash and hire-purchase terms. Whether due to the lower prices or the severe weather is uncertain, but it is certain that sales show considerable increase. In selling gas fires, a great deal more should be made of the live appearance of the gas fire—the substantial area of the heated space in contrast to the narrow strip of heat of the electric radiator, which requires to be helped out by a reflection from a chromium plate.

Domestic Water Heating.

My faith continues strong that to gas undertakings without an actual or potential demand for gas for industrial purposes no source of sales development is more helpful than that offered by domestic water heating. There is no scarcity of appliances, each of which suits some particular phase of hot water requirements. Our West of Scotland custom of a hot water storage system heated from the kitchen range or a back boiler in a living room fire inclines to make the gas circulator the appliance most commonly employed. Necessarily in our area water heaters must all be made of copper, and I can never understand why the copper appliances should be so much more costly than those made of steel or iron. The difference in the cost of the metals hardly seems to justify the large additional cost of appliances.

I am not a supporter of low combustion heaters of the thermal storage type. To me one great virtue of gas heating is that water can be heated quickly, and in my opinion every possible use should be made of this advantage over electricity. Slow water heating favours electricity, and it has to be remarked that the temperature of electrically heated water can be fixed at a higher point than in the case of gas heaters which are to work at their highest efficiency. Also I feel strongly favourable to the American type of snap-action thermostats which put the burner completely out leaving only a small pilot light, lighting up again when water is drawn or when storage has cooled down through radiation. I think the British manufacturers are wrong in adhering to the use of gradual-acting thermostats with what is called a maintenance consumption when the burner cuts down. There can be no question of the strength of the selling point that when the water is heated to the required temperature the burner cuts right out. "The consumption only when work is being done" is a good slogan. We push those of the rapid-heating type of thermal storage heaters with snap action thermostats ensuring high efficiency and the satisfactory results obtained have been most encouraging.

The single-point and multi-point instantaneous heaters now on the market combine high efficiency and attractive appearance. They also have the additional appeal that they consume only when doing a job of work. Unfortunately, in older houses it is usually necessary to lay a new supply pipe from the main and to fix a larger meter, a cost which the consumer is seldom willing to meet. The finding of a suitable outlet for the large flue pipe which is essential for safety often causes difficulty. In the winter time the flow of water has to be slowed down considerably on account of the low inlet water temperature. It is not always possible to heat the water to the same temperature as in the case of thermal storage appliances; effort to do so inclines to endanger the combustion chambers of the appliance. The greatest bugbear of copper appliances is deposition of copper carbonate and sulphate in the interior of the appliance, necessitating regular cleaning. One enterprising manufacturer is now producing heaters made of a well-known rustless metal at a reasonable cost.

The sink heater is useful in small houses, and we have a very large number in use with apparent satisfaction to our customers. Further experience with these heaters inclines to the belief that the cost of maintenance is a little high, and it is desirable to avoid cellulose paint finishes and use only enamel or chromium plate finishes. We supply all forms of water heaters on hire-purchase on very favourable terms, the general basis of charge being the list price divided over a period of five years with a discount for cash payment. The price includes gas fitting, but the water work, as already indicated, is carried out by plumbers whose bill is met by the customer ordering the appliance. Despite the large number of independent solid fuel boilers in use, we find this business progressive.

Central Heating.

A residential town containing a large number of houses which are centrally heated by means of solid fuel offers potentialities in the way of the adoption of gas for central heating. Recently I was inclined to press strongly the adoption of gas for central heating and to think the gas rates could be of a specially promotional nature; but the very severe weather of the winter which has passed created abnormal peak outputs of gas, necessitating the employment of the whole of the existing carbonizing plant, and has compelled the thought that it may be necessary to adjust opinion. The quantity of gas to be consumed per heating season in any ordinary residence, even of the larger size, is not sufficient to justify the price of, say, 3d. to 3½d. per therm. It may be taken that a quarter million cu.ft. is a reasonably large allowance of gas per season for most residences. I know there are people who would justify for even so small a quantity as above a gas rate as low as 3d. per therm by the argument that at no higher a price is the central heating load obtainable, but I think the consumption indicated is much too low to support such a view and further think the argument unsound because of the incidence of the load coming at the season of highest demand and also during daytime. It is quite clear that a large central heating load obtained at a very low price of gas might result in financial loss because of the necessity of high capital expenditure in the provision of additional gas making and gas storing plant, causing a reactionary effect on the standing charges in the summer time.

Our price for gas for central heating was 4¾d. per therm. We have some ten installations in regular use, and I will say that no customer who has adopted gas for central heating has shown the slightest inclination to go back to coal or coke. The difficulty is to get initial acceptance of the proposition that convenience is worth paying for even to the extent of from two to two-and-a-half times the cost of solid fuel.

Methods of Charge for Gas.

One of the great difficulties of Town Council control is that of overcoming a fondness for clinging to the traditional method of doing certain things, and that applies perhaps more than to anything else in respect of methods

of charge for gas. We have not yet departed from the flat rate method. However, perhaps it is not essential in view of our low base price of 5¼d. per therm for gas consumed by ordinary meters with discounts up to 10% for a consumption of 250,000 cu.ft. per annum. The question of tariff charges has been very much to the fore and will be more and more prominent, and I am convinced that it is vital to the welfare of the Industry that tariffs be scientifically constructed to the needs of each particular area and set of circumstances.

It is generally accepted that the "step rate" system nowadays possesses little possibility of encouraging higher consumptions. My own opinion is in favour of the two-part tariff system as I feel in the long-run the important thing is to be able to give prominence to the offer of low commodity prices. We are really indebted to the electrical industry for the development of this form of charge and experience, bitter to ourselves sometimes, shows that the standing or service charge once accepted is apt to be ignored in all calculations.

Examinations.

Because of my connection with the working of The Institution of Gas Engineers Education Scheme, a request has been made that I should make some reference to examinations.

The subject of examinations has recently created great interest and controversy following the publication of a report on Examination by a Committee which made special investigation of the subject, and an idea has gained ground that the result of examinations are influenced by chance to such an extent as to create doubts as to their accuracy and fairness. Such suggestion is disturbing because of the effect on careers of the results of examinations. It is obvious that very great care should be taken in the selection of examiners to ensure skill and judgment in the preparation and marking of papers. The drafting of examination papers is of the utmost importance, and it is no reflection on any man, however experienced and skilled in his profession, that he may have no aptitude in that direction. The questions set should be clear in meaning and intention without the slightest vagueness. The object of examinations should be to find out what a candidate knows, and a good examiner does not scheme to baffle the candidates.

Sometimes I think students complicate things for themselves, expecting and looking for traps where none exists. Laying traps shows a kind of cunning not found in good examiners. The element of time is of great importance for obviously the candidates answering the questions have not the experience of the examiner and require time to think, so that the time allowed should be distinctly more than the examiner himself would require. In the matter of Higher and Ordinary Grade Examinations I consider that a suitable broad division is that the Higher Grade should deal with principles where the Ordinary Grade should deal with detail. In marking the papers, the human element cannot be eliminated. No examiner can be expected to tackle the twentieth paper with the same keenness and zest with which he tackles the first paper. The reading over and over again of the same papers create a certain weariness, and that must be guarded against by not endeavouring to deal with too many papers at one sitting and by re-reading all papers in the reverse order. The setting of too high a standard should be guarded against by fixing maximum marks for each question, and when assessing answers a fairer relative idea of the adequacy of the answers is obtained if the same question is dealt with in all the papers successively instead of completing each paper separately.

Perhaps it is in the nature of parenthesis, but I feel that I must indulge myself in reference to handwriting, nowadays a rather neglected art. A feeling almost akin to resentment is caused by the paper written in careless sloppy writing, difficult to read, whereas a paper set out tidily in a legible hand creates a favourable impression at the outset, and I need not emphasize the great value of a good first impression. Handwriting is in many ways a guide to the character of the writer.

In the case of the Institution Examinations, every care is taken to avoid unfairness or injustice by referring all question papers to the scrutiny of a panel of examiners and all worked scripts to special assessors chosen because of their knowledge and experience. The system may not be perfect but is as fair as human care can make it.

In conclusion, looking back, I realize that a great deal of any success achieved at Helensburgh has been due to various Assistants who have provided the spur to experiment and effort. On that account I look forward to the future confident that it is safe in your hands.

Discussion.

The PRESIDENT (Mr. Alex. Bujnowski) paid tribute to the frank manner in which Mr. Fulton had stated his views. He agreed with Mr. Fulton that caution was necessary in promoting the use of gas for central heating since abnormal peak outputs were created. Failure in any installation would be the worst advertisement. They too had experienced difficulties with the master plumbers in Glasgow and had also overcome these. He considered that the design of gas cookers had not kept pace with some of its rivals and pointed out the excellent appearance and efficiency of the well-insulated solid fuel cookers.

Mr. J. WEBSTER (Port Glasgow) thought that there was no class of business which the Gas Industry could claim as its own, as was the case with the electrical industry regarding vacuum cleaners and all-mains wireless sets. He spoke of the good points of the Webson switch for lighting and of Mr. Bujnowski's special valve for snap action thermostatically controlled water heaters. He asked why Mr. Fulton had a step-rate system of tariff in Helensburgh when he did not believe in it. He suggested that a question on salesmanship should be included in the Gas Engineering and Supply Examinations and hoped that the Examiners would attend to Mr. Fulton's remarks concerning the marking of Papers.

Mr. R. A. MACLAREN (Newton-on-Ayr) said that in connection with the lighting load it was most important that switches should be installed. These were fitted by his Undertaking at a charge of 10s. 6d. to the consumer, and burners were fitted free. There had been a considerable increase in their lighting load. He said they did all their own gas and water heater fitting, outside plumbers being employed only for hire-purchase appliances, but this had been temporarily discontinued on account of the dimensions of the capital outlay. He also favoured the stamped steel cooker. Some people renovated "black" cookers, but it was their policy to break them up when returned. For domestic water heating he favoured the small sink heater of instantaneous type and the large multi-point model. They had obtained excellent results from gas installations in greenhouses.

Mr. W. KIRK (Motherwell) did not agree that the number of types of cookers should be limited. He asked how Mr. Fulton assessed the value of second-hand fires when replacing them with new ones. He considered that the slow thermal storage heater, since it evened out the load and did not usually require a new service pipe or meter, was preferable to the high-pressure heater. He asked Mr. Fulton the cost of converting a solid fuel central heating plant to gas.

Mr. FYFE (Kilmarnock) pointed out that the instantaneous type of water heater was difficult to install in the higher floors of a tenement, but he considered it ideal in other circumstances. They had the block system in Kilmarnock with special adjustments for public lighting. They had installed 900 hire-purchase appliances, including 700 cookers, in the past nine months and he wondered if they would, like Mr. Maclaren, have to call a halt owing to lack of capital.

Mr. WALKER (Kilbarchan) said they now favoured the instantaneous water heater. He asked why it should be that in the electrical industry every electrical engineer was a canvasser while the Gas Industry got so little assistance from the plumber. Regarding the multi-tariff charge system he asked Mr. Fulton if he did not think £1 per quarter was too high for the initial fixed charge. He said few consumers in Kilbarchan exceeded this amount in their bills with their step-rate system.

Mr. N. STURROCK (Greenock) said they had 7,000 black cookers in Greenock and could not replace them immediately but had now instituted a three and a five years' hire-purchase scheme. He did not agree that the step-rate could not encourage increased consumption. In Greenock there was a drop of 4d. per 1,000 cu.ft. after a consumption of 5,000 cu.ft. and this had been successful.

Mr. E. G. SMITH (Dumbarton) asked Mr. Fulton if, supposing he were using the block tariff system and had not much capital, he would raise the basic rate if the output decreased.

Mr. W. GLEDHILL (Stirling) asked if Mr. Fulton recommended the use of portable fires for several points.

Mr. MILNE (Greenock) held that electric lighting did not possess any advantages over gas lighting if switches were installed. With gas there was admittedly not the same latitude in positioning the lights, but its soft quality was restful to the eyes. It was unfortunate, he said, that ironmongers were allowed to sell cheap unattractive fittings.

Mr. NICOL (Greenock) asked if the consumer was charged the full cost of replacing old burners with new ones, and also why the cables for Webson and other switches could not be recessed into the plaster, and if the self-lighting gas mantle was a success. He further asked if it would not pay the undertaking to pay the service pipe and meter expenses rather than charge the consumer through the meter, on account of the increased consumption which would be obtained.

Mr. Fulton Replies.

Mr. FULTON, replying to Mr. Walker, said that the relationship between the Gas Industry and plumbers had always been difficult. There was more incentive for the electrician to go after business such as radio sets, &c. He thought the "instantaneous" water heater required for a reasonably quick supply of water was too large and expensive. Replying to Mr. Webster, he said that he was unable to get his Committee to depart from the step-rate. They also sold switches at 10s. 6d. The Webson switch was good but it was very

difficult to get delivery. In reply to Mr. Kirk, he said that there was very little difference between most of the gas cookers and if they could be standardized they would be cheaper. He thought the stamped steel cooker was excellent, and, moreover, it gave a superior surface for vitreous enamelling than cast-iron ones. In Helensburgh they made no allowance for black fires, since this would increase the cost of all fires supplied. The cost of converting a sectional boiler from solid fuel to gas firing was about £10 *plus* the cost of the service pipe. It would, of course, be better to have a boiler specially designed for gas firing thus obviating the large number of adjustments to be made in burners, &c., after conversion. It was necessary to remember whether the new business was worth the premium paid in giving free service pipe, meter, &c.

He advised the raising of the basic rate of the block system in the instance stated by Mr. Smith. He considered the basic rate too low in Helensburgh. A multi-tariff system, he said, must be optional with another form of charging. He agreed with Mr. Milne that the quality of gas lighting should be stressed and suggested that Undertakings should sell all fittings.

On the PRESIDENT'S proposal a very hearty vote of thanks was accorded to Mr. Fulton.

Continuous Hardening and Tempering

Gas-Fired Plants in Successful Operation.

OF SMALL STEEL PARTS

One of the characteristic tendencies of present-day furnace and oven design is the movement towards continuity of operation. In the sphere of heat treatment of metals the difficulties attendant upon continuous operation are considerably greater than in the case of low-temperature processes, and though many furnaces are now available for the simpler processes there is a growing demand for equipment capable of the continuous hardening and tempering of small steel parts.

The Gas Light and Coke Company has recently installed two gas-fired plants for this process. The plant consists of three main parts:

(*a*) The hardening furnace.
(*b*) The quenching tank.
(*c*) The tempering furnace.

Hardening Furnace.

This consists of an oven furnace having inside dimensions 4 ft. 1½ in. long by 1 ft. 6 in. wide by 6 in. high to the crown of the arch and is built up of refractory brick backed up with insulating brick and housed in a mild steel casing. Firing is by means of bunsen burners using gas at ordinary mains pressure, the hot gases passing under the floor tray and out through flues situated in the crown of the furnace.

At the discharge end a 6 in. diameter heat resisting steel finned roller is fitted, over which a 16 in. wide nichrome wire belt passes. This is driven by a ½ h.p. motor with reduction gear on to a ratchet drive on the hexagonal roller shown on the diagram, at the loading end of the furnace. A chain drive from the loading roller assists the movement of the heat resisting steel roller. The speed of the belt can be varied according to the size of the parts being heat treated and the consequent time required in the furnace. A normal speed with small parts is 1 ft. per minute. The furnace is capable of operating at temperatures up to 1,000° C. and the maximum hourly gas rate is 400 cu.ft.

The discharge from the furnace consists of a chute, oil cooled and constructed as shown in the diagram to minimize the amount of heat radiated on to the oil in the quenching tank.

A gas burner is fixed at the point where the belt leaves the furnace, in order to reduce the quantity of air entrained and to assist in the heating of the discharge roller.

A thermostat of the relay type is fitted as well as a pyrometer.

Quenching Tank.

The quenching tank, which has a capacity of 100 gallons, has provision for water cooling and is fitted with a small rotary pump to circulate the oil in the tank and in the chute.

A wire mesh belt, with a chain drive from the discharge roller, carries the articles out of the bath to the tempering furnace, and is arranged to give a suitable dwell in the oil.

Cross struts to carry the hardened parts are fitted to the belt and a wire brush removes any surplus oil.

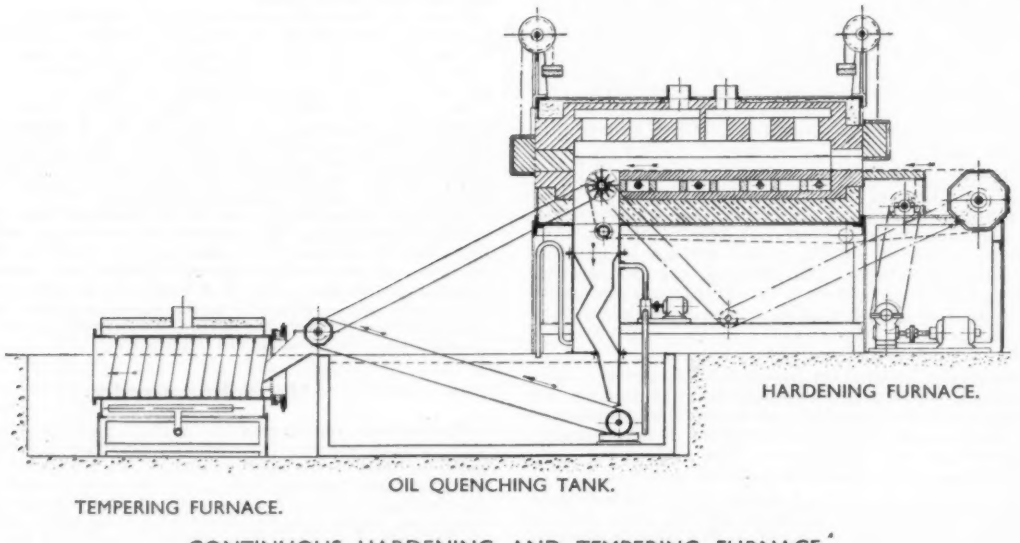
Tempering Furnace.

The tempering furnace consists of a cast iron drum, 1 ft. inside diameter by 3 ft. long, made in one piece with a spiral guide on the inside. The drum rests horizontally on four rollers and is fired by means of bunsen burners using gas at ordinary mains pressure, with a maximum hourly gas rate of 120 cu.ft. and capable of working at temperatures up to 750° F. A double-cased mild steel cover lined with slag wool surrounds the drum.

The drum is driven by a ½ h.p. motor through reduction gear and chain drive, at a speed to allow a suitable stay in the tempering zone. A thermostat of the relay type is fitted.

The equipment in question is used for hardening and tempering "Circlips" (the spring clips used for securing the gudgeon pin of internal combustion engines in position).

These vary in diameter and thickness, but for medium



CONTINUOUS HARDENING AND TEMPERING FURNACE.

sizes a dwell of three minutes in the hardening furnace, two minutes in the oil, and ten minutes in the tempering furnace is allowed. The hardening temperature is 780° C. and the tempering temperature is 700° F.

It will readily be seen that with equipment of this type many difficulties have to be overcome, particularly with regard to the driving of the heat resisting roller. It was found necessary to use a special ball race with extra large clearances, and it was necessary to lubricate with graphite.

The belt naturally stretches considerably and provision has to be made to take up slack.

In order to obtain scale-free work it is necessary to exclude air from the furnace, and difficulties have to be overcome at the point where the belt leaves the furnace. A jockey pulley was fitted so that the slot for the exit of the belt could be kept to a minimum. As stated above a gas burner was fitted at this point.

The quenching oil is heated not only by the parts being quenched—in this particular case a comparatively small item—but also by conduction down the chute and by radiation from the hot belt.

Violent agitation of the oil was found to be necessary and the chute was oil cooled, by means of a circulating pump.

The shape of the heat treated parts is such that they catch up very easily, and it was found necessary to use a very fine mesh on the belt in the quenching tank, and in order to save space the angle of the belt is such that a hinged flap is necessary to prevent the "Circlips" from falling off. The fine mesh belt naturally carries oil in the mesh, and a wire brush was found necessary to remove this before the parts enter the tempering drum.

Other difficulties encountered were the firing of the oil in the tempering drum and the looping of the "Circlips" over the thermostat.

These difficulties have been overcome, and there should now be found a field for the use of furnaces of this type.

In accordance with the Gas Light and Coke Company's usual practice any furnace maker interested in the design, or further development which is obviously necessary, may have a complete set of drawings, as for obvious reasons the Gas Light and Coke Company do not wish, in any circumstances, to compete with manufacturers who are quite capable of manufacturing this type of equipment.

British Gas Light Company, Ltd.

The Two Hundred and Fifth Ordinary General Meeting of the British Gas Light Company, Ltd., was held at the Chief Offices of the Company, 2, The Abbey Garden, Westminster, S.W. 1, on Wednesday, March 18—Mr. HENRY WOODALL, M.Inst.C.E. (Chairman and Managing-Director), presiding.

The SECRETARY (Mr. A. J. Mumford) read the notice convening the meeting and the Reports of the Auditors. The Directors' Report and Statement of Accounts for the year ended Dec. 31, 1935, were taken as read.

THE CHAIRMAN'S ADDRESS.

The CHAIRMAN said: The Report records the death of our old friend and colleague, Mr. A. W. Brookes. He served us for the long period of 57 years. He began in a very junior post and became our Chief Official and eventually a Director. His kindliness and devotion to duty earned for him the affection and respect of his staff and colleagues. The high standard he set will be long remembered and, I trust, maintained.

Turning to the Capital Account, we have redeemed the £29,500 Norwich 6% mortgage debentures and re-issued them at 4%. This was referred to at the last Annual General Meeting, although the transaction relates to the year now under review.

In exercise of their powers under the conditions of issue the Directors have given notice of the redemption on June 30 this year of the outstanding £70,500 Norwich 7½% mortgage debentures at 102 and propose to re-issue them at 3½%, the existing holders being given the opportunity of taking up the re-issued debentures in exchange for those to be redeemed—a very large percentage have availed themselves of the offer. Both issues will be redeemable at par on July 1, 1960.

Additional loan capital was raised during the year by the issue of £200,000 3½% debenture stock. This stock was taken up privately, and is redeemable at par on July 1, 1955.

Greater Aggregate Profits.

We have now altogether, including our Chemical Works, 36 undertakings, of which 23 are Subsidiary Companies in which we hold the controlling interest. At all of our Stations we have made profits which in the aggregate are greater than last year in spite of a small decrease in the sale of gas.

Hull, as you know, is our Chief Station, and for the last five years we have had to draw on the Reserve Fund, created for the purpose, to pay our full interest charges. This year, however, I am glad to tell you that my prophecy of last year has come true quicker than I expected, and we have been able to add £766 to the Reserve Fund. We did raise the price of gas by ½d. per therm, but it is still at the low figure of 7½d. per therm. The result of the increase in price, which operated for only part of the year, was an addition to profits of £7,295. The reason we have done so well is primarily the reduction in the cost of manufacture and distribution. This improvement reflects great credit on our Chief Engineer, Mr. C. Rhodes Armitage.

At Norwich we have had a good year, making slightly increased profits and adding over £5,000 to the Reserve Fund. In 1931 we had recovered all back dividends and since then have accumulated a Reserve Fund of £28,500.

Both the Hull and Norwich Reserve Funds are fully invested outside the business.

I do not propose to trouble you with details of the other Stations, but would only repeat that they are all doing well and the average return which we receive from them is steadily rising. As you know, we were the first, and at one time the only, holding gas company; and though we still acquire undertakings, with money at its present value the return on later acquisitions is not so good as in the case of earlier purchases.

The result of the year's working is that after payment of debenture and other interest and preference dividends there is £64,863 available compared with £59,839 for 1934. Out of this sum an interim dividend of 3½% has been paid and £15,000 has been transferred to the General Reserve Fund; and if the usual final dividend of 4% be paid the balance forward will be increased by £166 to £88,328.

New Acquisitions.

In 1932 we acquired the whole of the share capital of the Ruthin Gas Company. Since its acquisition the Works have been modernized, a considerable amount of main-laying has been carried out, and modern cookers and other gas appliances have been placed at the disposal of the consumers, with the result that sales of gas are showing very satisfactory increases.

The Ruthin Company, however, is an unlimited company working under somewhat out-of-date powers, and the Directors came to the conclusion that it would be advantageous to obtain an up-to-date Order and to make the undertaking a station of the Parent Company. The transfer will not involve any additional capital expenditure as we already own the undertaking. It is anticipated that the Order will shortly be made by the Board of Trade.

Two new Stations were acquired during the year—namely, Diss and Brandon. We have also taken over the Thetford Undertaking, but this is not shown in the Accounts as the purchase was not completed until Jan. 1 this year.

Considerable sales of appliances have again to be recorded. A number of these appliances replaced old and less efficient apparatus with the result that the purchaser obtains the same service with less gas consumption. Particularly is this the case with the new cookers which actually show a saving of some 25% to 30% in the quantity of gas used. Our output of gas thus suffers temporarily, but there can be no doubt as to the soundness of the policy of enabling the public to obtain maximum efficiencies from the use of gas.

The number of our consumers continues to increase. During the year we had an addition of over 5,000 in all, but the consumption *per capita* shows a downward tendency. This is in part due to the more efficient apparatus to which I have referred, but the changing habits of the people also have a bearing—the motor car and the cinema tend to take them from home, and the increasing popularity of tinned foods reduces the amount of cooking.

The increasing use of gas for fires, water heating, and, now, refrigeration will tend to counteract the reduction of consumption in other directions.

The extensions of the carbonizing and ancillary plant at Trowbridge were completed during the year, and Bradford-on-Avon has been supplied with gas from that Works since

October. Further additions to the plant are under consideration.

Coal.

You are no doubt aware that this Company has, with other public utility undertakings, agreed to a voluntary increase of 1s. per ton on contract prices for coal. An increase in contract prices is clearly undesirable and was only agreed to after most careful consideration. The Government urged it upon us. We have not forgotten the 1926 strike which did such incalculable and permanent injury to our great coal industry, and we knew that public opinion, with which we cordially agreed, was in favour of help being given to the miners. The result has been that peace for the moment has been secured in the coal industry, and it is given time to consider the position in a better atmosphere.

One of the main troubles is that under the Coal Mines Act of 1930, collieries, whether efficient or inefficient, are allotted quotas. The result of this is that the men are working short time and are naturally dissatisfied. The owners of well-run, efficient pits are not able to take advantage of their enterprise, which is discouraging, and the consumer has to pay more for his coal. It seems to me that something on the lines of the Compensation Levy, such as exists for compensation of Licensed Houses which are regarded as redundant, might well be considered by the coal industry, and thereby enable them to deal with redundant collieries and dispossessed workmen.

Our coal resources have been and are one of our greatest assets and the basis of a large amount of the wealth of this country. The coal industry as a whole is still potentially a wealthy one, and we, who so largely depend upon it, want to be assured that the Government proposals are not based on an assumption that the industry cannot, if properly re-organized, work out its own salvation. We view, with some apprehension, the proposed selling agencies. They are apparently to be given large and very arbitrary powers and the right of appeal as at present suggested would appear to be of little value.

Coal consumers must be protected and permitted to purchase coal from whom they wish. Our Works are now so arranged as to make use of types of coal most easily accessible, and I have already heard of people finding difficulties put in the way of obtaining the coal to which they are accustomed and for the use of which their plant is designed. The Gas Industry and other public utility undertakings are, you may be sure, making every effort to see they are provided with proper safeguards.

Encouraging Prospects.

In conclusion, the prospects of our Undertaking are encouraging. This year has started well and the gas sales are improving all round. In 1935 we added more consumers than ever and sold a larger number of gas-using appliances. It is pleasant to meet quite frequently people who no longer commiserate with one as connected with a dying industry. There are few industries in which greater improvements have been made in recent years than in our own. Appliances for using gas have been enormously improved and its adaptability is becoming more and more appreciated.

The time is coming when the use of raw coal will be greatly reduced and people will insist on obtaining their heat and power, as well as their light, by the turning of a tap or the use of a switch.

You will have seen recently reported many speeches of Chairmen of Gas Companies at their Annual Meetings and their tone has been distinctly optimistic. All we ask is a fair field and no favour.

The CHAIRMAN then formally moved the resolution for the adoption of the Report and Accounts, which was seconded by the DEPUTY-CHAIRMAN (Mr. Harold G. Palmer).

Mr. S. O. STEPHENSON observed that he was glad the Chairman had emphasized the seriousness of taking away their freedom in regard to the selection of their coal. They had a distinct recollection of the war-time period when they were forced to have coal of an undesirable character which definitely increased the cost of gas manufacture. They owed the Chairman a debt of gratitude for drawing attention to this matter.

The resolution for the adoption of the Report and Accounts was then put to the meeting and carried unanimously.

Dividends.

The CHAIRMAN then moved that the payment of the dividends at the rate of 7% per annum, less income-tax, on the cumulative preference stock and 5½% per annum, less income-tax, on the "B" redeemable cumulative preference stock as mentioned in their Report be confirmed.

This was seconded by the DEPUTY-CHAIRMAN and agreed to.

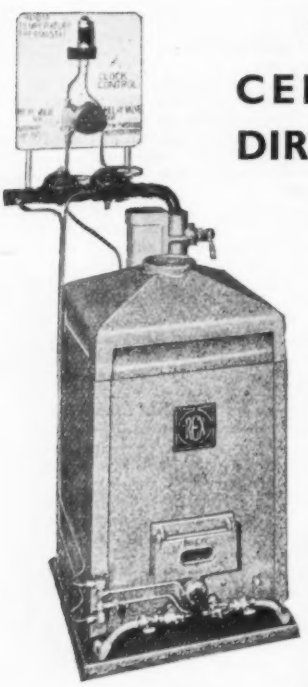
The CHAIRMAN next moved that the payment by the Directors of the interim dividend at the rate of 3½%, less income-tax, on the ordinary stock, as mentioned in their Report, be confirmed, and that a final dividend on the ordinary stock at the rate of 4%, less income-tax, making 7½% for the year, less income-tax, be now declared, the same to be payable on April 3 next, and that the dividend warrants be sent by post to the last known address of each proprietor unless instructions had been received to the contrary.

This was also seconded by the DEPUTY-CHAIRMAN and unanimously agreed to.

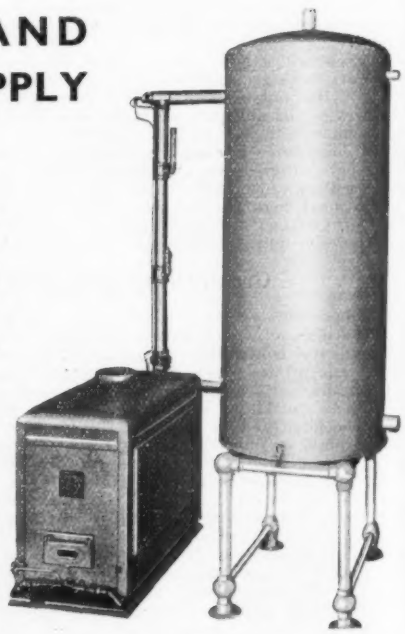
"REX"

(Potterton's Patent Gas Fired Boilers)

CENTRAL HEATING AND DIRECT HOT WATER SUPPLY



An important combination, the "REX" Central Heating Boiler with its Water Thermostat, Automatic Cut-out, Remote Control and Time Switch, and a "REX" Heater for "Direct" Hot Water Supply, 200 gallons Storage for large industrial installations, Hotel and Factory uses. For soft water districts "REX" Boilers can be applied with "Indirect" Hot Water Cylinders



Our Exhibit—
"IDEAL HOME" EXHIBITION
OLYMPIA
STAND No. 51
GRAND HALL, GROUND FLOOR

THOMAS POTTERTON (Heating Engineers) Ltd.
RAVENSWOOD ROAD, BALHAM, LONDON, S.W. 12

Re-Election of Directors.

The CHAIRMAN then moved the re-election to the Board of Mr. H. G. Palmer. Mr. Palmer was the oldest member of their Board, having joined the Company on July 1, 1914. He followed his father, who was a Director of the Company for forty-three years in all and Chairman for twenty-four. They had known Mr. Palmer for a considerable time, and he was a very valuable Director.

Mr. GRAHAM WILKIN seconded the resolution, which was carried unanimously.

The CHAIRMAN also moved the re-election of Mr. H. F. H. Jones, and, in doing so, he remarked that Mr. Jones was known to most of those present. He had not been with them very long, but they already recognized his value to them. Mr. Jones was the fourth generation of distinguished Gas Engineers, and he was sure he would continue to uphold the record of which his family was so justly proud.

Mr. H. G. PALMER seconded this resolution, which was carried unanimously.

Re-Appointment of Auditors.

On the proposition of Mr. S. O. STEPHENSON, seconded by Mr. KENNETH R. MACKAY, the Company's Auditors (Mr. E. Knowles Corrie and Mr. William Cash, Jnr.) were unanimously re-appointed, Mr. CASH briefly acknowledging this renewal of their confidence on behalf of Mr. Corrie and himself.

Votes of Thanks.

Capt. W. J. LIBERTY proposed a hearty vote of thanks to the Chairman and Directors for their able management of the business of the Company during the past year. The duties of the Chairman and Directors of a Holding Company such as this, he said, were no light matter, and if they considered the ever-increasing number of Stations—which the statement at the back of the Report showed to be thirty-six—it meant that their Chairman and Directors could have very little time to themselves. They must be here, there, and everywhere working for the Company throughout the year, getting round to the various undertakings and seeing that things were being kept up-to-date. The remarks which their Chairman had just made showed that he was fully alive to all those matters which concerned the Gas Industry.

Lieut.-Col. H. W. WOODALL seconded the vote of thanks, which was carried unanimously.

The CHAIRMAN, in acknowledgment, remarked that they did cover a rather large area and had to travel a good deal and spend a considerable amount of time in connection with the affairs of the Company.

From the map attached to the Report it would be seen that they possessed works all over the country.

The Chairman went on to propose a hearty vote of thanks to the Secretary, Officers, Staffs, and Workmen. He believed that all their employees were contented and happy in their work. The Directors provided means of recreation and these were greatly appreciated, as also were the Pension Funds. The results proved that the Staff and workpeople all pulled their weight to the benefit of the whole concern.

The DEPUTY-CHAIRMAN seconded the vote of thanks, which was carried unanimously.

The SECRETARY, in acknowledgment, said that the officers, staff, and workmen would all be very gratified to receive this vote of thanks which had been proposed in such a cordial way by the Chairman and so well received by the meeting. Close co-operation and harmony were very necessary for the smooth working and continued success of any company—particularly so in an undertaking like theirs whose interests were widely distributed. He could say without reservation that their people were all pulling well together and maintaining—and even increasing—that high standard of efficiency and service which had been set in the past. They greatly appreciated this recognition of their efforts, and they would at the same time, he knew, wish him to express their thanks to the Board for the consideration and encouragement which they always received at their hands.

The proceedings then terminated.

A Gum Inhibitor

Polish Manufacture

We have received from Dipl. Eng. W. de Piotrowski and Dr. J. Winkler, of the Chemical Research Laboratory of Galicja, Ltd., Poland, an account of the manufacture of various products by the catalytic oxidation of hydrocarbons in the vapour phase. Among these products are "Detectol O. Special," for use as an odorant, and "Denoxol Solve." It is claimed for the latter compound that, in addition to being a solvent for naphthalene, it will prevent the formation of gums in town gas—an effect similar to the inhibition of gum formation in benzoles.

It is also claimed for "Denoxol Solve" that it has great dissolving power for preformed gums and resins even at low temperatures, and that it is useful as a preventive of internal corrosion of mains and services.

THE
STANTON MECHANICAL
LEAD JOINT

NO INCREASE IN COST OF PIPELINE

The troublesome operations of lead melting, running and caulking are dispensed with in this new lead joint. To make the joint, a *pre-cast* lead ring is slipped over the pipe spigot, two half-collars are placed in position, and the operation is completed by tightening four high-grade, cast-iron setscrews with an ordinary spanner.

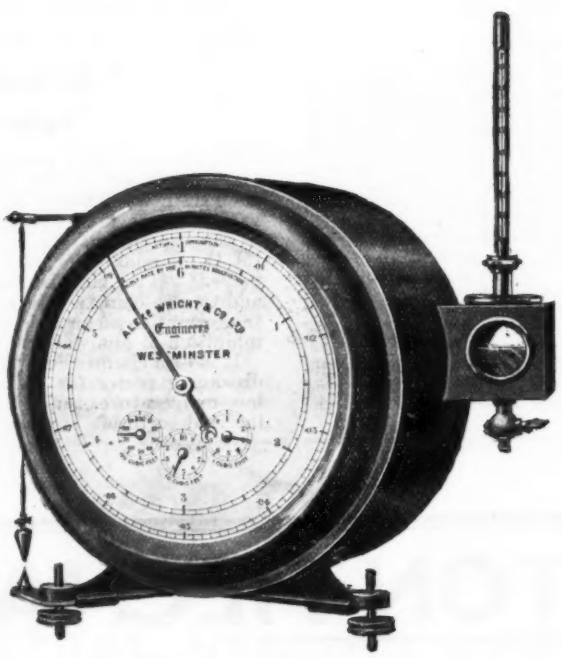
The lead ring is positively held in position by the half-collars, and cannot be dislodged. A steel spring insertion ring, cast inside the lead, serves to distribute the end pressure so that the lead makes effective contact throughout its full depth.

Patent Nos. 404955 and 433137

THE STANTON IRONWORKS
COMPANY LIMITED, Near NOTTINGHAM

LABORATORY GAS METERS

of Precision *and* Quality



In various sizes from
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Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

During the present political tension investors are naturally curtailing their commitments so that the volume of business on the Stock Exchange last week was on the light side. Despite this, however, markets were in a comparatively cheerful frame of mind, and in the absence of any further liquidation by nervous holders prices substantially recovered. A fillip was given to the gilt-edged market by the announcement of the Government's intention to maintain its policy of cheap money. Home rails also improved though the market was almost idle. A feature was a further batch of industrial reports showing larger profits and increased dividends. The present week will doubtless be a critical one, but markets are ready for a quick response to better news.

In common with other departments, business in the Gas Market was again subdued though prices were well maintained and showed little change. The only feature on the London Exchange was the strength of Imperial Continental Gas, which finally closed 15½ points up on the week at 178-183, recorded transactions ranging from 165 on Monday to 182¾ on Friday. Alliance and Dublin was marked *ex* div. but quickly recovered the drop on account of the increase of 12s. 6d.% in the final dividend and closed without change. Commercial ordinary hardened a fraction, and Brighton 5% moved up 2 points to 157½. Other than *ex* div. reductions, the only setback was a small drop in South Metropolitan ordinary to 122½. Prices at the Provincial Exchanges were practically unaltered, while in the Supplementary List the only change of note was a sharp rise of 9 points in Yorktown (Camberley) 5% consolidated to 129½.

A first dividend announcement has been made by the Directors of the United Kingdom Gas Corporation, who are recommending a distribution of 5% per annum on the ordinary shares numbered 1 to 500,000 inclusive calculated to Dec. 31 last from the due dates of payment of the instalments. Another dividend announcement last week was that by the Directors of the Bombay Gas Company who are recommending a final dividend on the ordinary shares of 4½%, making 8% for the year, the same rate that has been paid since 1930. These shares can be purchased at round about 27s., and the yield on this basis works out at £5 18s. 6d.%.

Particulars have been received of an issue by the Great Yarmouth Gas Company of £11,000 4% perpetual debenture stock at a minimum of par. For the past fifteen years the maximum dividends have been paid on the Company's ordinary capital, while the available balance at Dec. 31 last was sufficient to cover the interest on loan capital, including the new issue, about three times. Two months' interest will be paid on July 1 next, and thereafter on Jan. 1 and July 1. The last day for receipt of tenders is Saturday, April 4.

Current Sales of Gas Products

The London Market for Tar Products.

March 23.

There are no changes to report in the tar products market, prices being as follows:

Pitch, about 42s. 6d. per ton f.o.b.
Creosote, 5½d. per gallon.
Refined tar, 3¾d. per gallon in bulk at makers' works.
Pure toluole, about 2s. 8d.; pure benzole, 1s. 7d. to 1s. 8d.; 95/160 solvent naphtha, about 1s. 8d.; and 90/160 pyridine, about 4s. 3d. to 4s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

March 23.

The average prices of gas-works products during the week were: Gas-works tar, 24s. 3d. to 29s. 3d. Pitch—East Coast, 42s. 6d. to 45s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 42s. 6d. to 45s.* Toluole, naked, North, 2s. 2d. to 2s. 4d. Coal-tar crude naphtha, in bulk, North, 8d. to 8¼d. Solvent naphtha, naked, North, 1s. 6d. to 1s. 6½d. Heavy naphtha, North, 1s. to 1s. 1d. Creosote, *ex* works, in bulk, North, liquid and salty, 4⅜d. to 4⅞d.; low gravity, 4⅜d. to 4⅝d. Heavy oils, in bulk, North, 4¾d. to 5d. Carbolic acid 60's, 2s. 4d. to 2s. 6d. Naphthalene, £19 to £21. Salts, 95s. to 100s., bags included. Anthracene "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *March* 21.

Market continues quite active and, in certain articles, there is now a distinct shortage.

Crude gas-works tar.—The actual value is 32s. to 33s. per ton *ex* works in bulk.

Pitch remains uninteresting at 35s. to 37s. 6d. per ton f.o.b. Glasgow for export, and 35s. per ton *ex* works in bulk for home trade.

Refined tar.—A moderate business is being conducted for delivery over the coming season at 2¾d. to 3d. per gallon, f.o.r. makers' works naked.

Creosote oil.—Production continues to be well looked after and values are not lower than the following: B.E.S.A. Specification, 5⅛d. to 5⅜d. per gallon; low gravity, 5¼d. to 5½d. per gallon; and neutral oil, 5¼d. to 5½d. per gallon; all f.o.r. in bulk.

Cresylic acid.—Supplies are now rather difficult to secure in this district, particularly for prompt delivery, and prices are therefore nominal as follows: Pale, 97/99%, 1s. 7d. to 1s. 7½d. per gallon: dark, 97/99%, 1s. 5d. to 1s. 5½d. per gallon; and pale, 99/100%, 1s. 10d. to 1s. 11d. per gallon; all *ex* works naked.

Crude naphtha commands 5⅛d. to 5⅜d. per gallon, according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 4½d. to 1s. 5½d. per gallon, and 90/190 heavy naphtha is 1s. to 1s. 1d. per gallon.

Motor benzole.—Available supplies are offered at 1s. 3½d. to 1s. 4d. per gallon in bulk at makers' works.

Pyridines.—90/160 grade is 5s. to 5s. 6d. per gallon, and 90/140 grade is 5s. 6d. to 6s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole	0	8½	to	0	9	per gallon at works
Motor "	1	2	"	1	2½	" " "
90% "	1	3	"	1	3½	" " "
Pure "	1	7	"	1	7½	" " "

Contracts Advertised To-Day

Gasholders, &c.

Earby and Thornton Gas and Lighting Company. [p. 846.]
Warrington Gas Department. [p. 846.]

Pipes, &c.

Coventry Gas Department. [p. 846.]

Retorts.

Maryport Gas Department. [p. 846.]

Trade Notes

Paint Firm's Gratifying B.I.F. Results.

Messrs. Gittings & Hills, Ltd., Paint and Varnish Manufacturers, of Tower Works, Nechells, Birmingham, state that they experienced "very gratifying results" at the Birmingham Section of the British Industries Fair this year. Substantial orders were booked, while enquiries from many of the largest users of industrial finishes for the firm's recently developed "Rockhard" synthetic enamels and lacquers are confidently expected to result in considerably increased activity in the departments concerned.

Gibbons (Dudley), Ltd.

Annual Report of the Directors

The Directors of Messrs. Gibbons (Dudley), Ltd., report a net profit for the year ended Dec. 31, 1935, after providing for income-tax and depreciation, of £15,039, which, added to the amount brought forward from last year, £12,099, makes a total of £27,138. From this amount the full 7% preference dividend, free of income-tax, for the year, was paid on June 30 and Dec. 31, 1935, absorbing £2,100, leaving a balance of £25,038 to be now dealt with. The Directors recommend that a dividend of 9% on the ordinary shares, less income-tax, be paid, £9,824, further Directors' fees £450, to write off part of the cost of modernizing the works £3,000, and to carry forward to next year £12,259.

Get the most out of every class of coal in every size of works by adopting

THE WEST SYSTEMS

- GLOVER-WEST VERTICAL RETORTS
- WESTVERTICAL CARBONIZING CHAMBERS
- COAL AND COKE-HANDLING & PREPARATION

Orders for Glover-West vertical retort installations have been received during the present year from the Dudley, Brierley Hill & District Gas Company (3rd order), the Kelso Gas Company, Ltd., the Altrincham Gas Company (3rd order), the Bilston Gas, Light & Coke Company (2nd order), and the Grangemouth Corporation Gas Department (2nd order).

- Carbonizing plants have been recently put into commission at Stratford-on-Avon, Buxton, Kilsyth, Montrose (2nd order), Manchester (6th order), Slough, Johannesburg (2nd order), St. Helens (4th order), St. Albans and Willenhall.

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LONDON: Columbia House, Aldwych, W.C. 2 — 'Phone: HOLBORN 4108 : 'Grams: "WESGASCO, ESTRAND, LONDON"

STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mar. 20	Rise or Fall on Week.	Transactions, Lowest and Highest Prices During the Week.
1,767,439	Stk.	Mar. 16	7	7⅛	Alliance & Dublin Ord. ...	145—155*	...	148
374,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb. ...	95—100	...	...
557,655	,,	Feb. 17	7	7	Barnet Ord. 7 p.c.	164—169	...	...
300,000	1	Oct. 7	1 9/16	1 4/16	Bombay, Ltd.	1 15/16—1 17/16	...	26/6—28/-
179,305	Stk.	Mar. 2	9½	9½	Bournemouth sliding scale ...	218—228	...	...
590,407	,,	,,	7	7	Do. 7 p.c. max. ...	169—174	...	...
493,960	,,	,,	6	6	Do. 6 p.c. Pref. ...	148—153	...	...
50,000	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	85—90	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	125—130	...	...
357,900	,,	Feb. 17	7⅛	7⅛	Brighton, &c., 6 p.c. Con. ...	170—175	...	...
649,955	,,	,,	6 2/3	6 2/3	Do. 5 p.c. Con. ...	155—160	+2	155—159
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	144—149	...	...
855,000	,,	Mar. 2	7	8	British Ord.	158—163	...	161—161½
100,000	,,	Dec. 16	7	7	Do. 7 p.c. Pref.	153—158	...	156
350,000	,,	,,	5⅛	5⅛	Do. 5½ p.c. 'B' Cum. Pref.	110—115	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	96—101	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	107—112	...	...
200,000	,,	,,	17/6⅝	3½	Do. 3½ p.c. Red. Deb. ...	98—100	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	...	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	...	...
150,000	Stk.	Jan. 6	4⅝	4⅝	Do. 4½ p.c. Deb. ...	81—86	...	...
626,860	,,	Feb. 3	6	6	Cardiff Con. Ord.	131—136	...	...
98,936	1	Sept. 23	2/-	2/-	Colombo, Ltd., Ord.... ...	1 13/16—1 15/16	...	...
24,500	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	20/—22/-	...	...
609,204	1	Oct. 7	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	19/6—21/6	...	...
296,053	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref	23/6—25/6	...	...
1,775,005	Stk.	Feb. 3	5	5	Commercial Ord.	99—103	+½	100—101
620,000	,,	Dec. 2	3	3	Do. 3 p.c. Deb. ...	85—90	...	...
286,314	,,	Feb. 17	5	5	Do. 5 p.c. Deb. ...	119—124	...	...
807,560	,,	,,	7	7	Croydon sliding scale ...	157—162	...	159
644,590	,,	,,	5	5	Do. max. div.	113—118	...	...
620,385	,,	Dec. 16	5	5	Do. 5 p.c. Deb.... ...	121—126	...	123—124½
239,000	,,	Feb. 3	5	5	East Hull Ord. 5 p.c.... ...	107—110	...	105
184,555	,,	Feb. 17	6	6	East Surrey Ord. 5 p.c. ...	130—135	...	...
176,211	,,	Dec. 16	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
19,284,128	,,	Feb. 3	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	27/3—28/3a	...	27/6—28/-
2,600,000	,,	,,	3⅓	3⅓	Do. 3½ p.c. max.	89—92	...	...
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	107—110	...	107½—108½
8,602,497	,,	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	88—93	...	88—90⅛
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	117—120	...	118—119½
3,500,000	,,	,,	4⅓	4⅓	Do. 4½ p.c. Red. Deb. ...	114—117	...	114¼—115¾
270,466	,,	Feb. 17	6	6	Harrogate New Cons. ...	130—135	...	133½
157,500	1	Mar. 16	1/7½	1/7½	Hongkong & China, Ltd. ...	1 13/16—1 7/16*	−1/16	...
213,200	Stk.	Mar. 2	6	6	Hornsey Con. 3½ p.c. ...	135—140	...	...
5,600,000	,,	Nov. 4	14	8	Imperial Continental Cap. ...	178—183	+15½	165—182¾
223,130	,,	Jan. 20	3½	3½	Do. 3½ p.c. Red. Debs.	92—97	...	95—95½
285,242	,,	Feb. 17	8⅛	8⅛	Lea Bridge 5 p.c. Ord. ...	172—177	...	...
165,736	,,	Mar. 16	8	10	Maidstone 5 p.c. Cap. ...	180—190*	−2	...
63,480	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	80—85	...	...
75,000	,,	Dec. 2	†10	†10	Malta & Mediterranean ...	200—210	...	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	102—107	...	...
231,978	Stk.	Feb. 17	5	5	M.S. Utility 'C' Cons. ...	110—115	...	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	102—107	...	...
360,075	,,	Dec. 16	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
148,955	,,	,,	5	†5	Do. 5 p.c. Deb. ...	123—128	...	...
125,000	—	Jan. 2	3½	3½	Do. 3½ p.c. Rd. Rg. Bds.	96—99	...	...
675,000	Stk.	Nov. 18	†3	†3	Montevideo, Ltd.	60—65	...	...
225,000	,,	Feb. 17	7½	7½	North Middlesex 6 p.c. Con.	169—174	...	...
396,160	,,	Feb. 3	5	5	Northampton 5 p.c. max. ...	108—113	...	...
300,000	,,	Nov. 4	†7	†9	Oriental, Ltd....	167—172	...	...
416,617	,,	Dec. 16	8	8	Plymouth & Stonehouse 5 p.c.	166—171	...	...
504,416	,,	Feb. 3	8¼	8¼	Portsm'th Con. Stk. 4 p.c. Std.	170—175	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	108—113	...	...
114,000	,,	Feb. 3	5	5	Preston 5 p.c. Pref. ...	110—115	...	...
321,961	1	Sept. 23	...	1/-	Severn Val. Gas Cor. Ld. Ord.	22/—23/-	...	22/6—22/7½
319,510	1	Mar. 16	-/10½	-/10½	,, ,, 4½ p.c. Cum. Pref.	21/6—22/6*	−/3	21/6—22/1½
133,201	Stk.	Feb. 17	8½	5	Shrewsbury 5 p.c. Ord. ...	147—152	...	149½—150½
90,000	10	May 27	†3	†3½	South African...	3—4	...	...
1,061,779	1	Sept. 23	1/2½	1/2½	South East'n Gas Cn. Ld. Ord.	27/—29/-*	...	27/3—27/6
845,016	1	Mar. 16	-/10½	-/10½	Do. 4½ p.c. Red. Cum. Pref.	21/—23/-	—/9	21/9—22/6
200,000	1	,,	4	4	Do. 4 p.c. Cum. Pref. ...	20/9—21/9*	—/3	...
450,000	Stk.	Feb. 17	4	4	Do. 4 p.c. Red. Deb. ...	101—104	...	...
6,709,895	,,	Feb. 3	5	6⅔	South Met. Ord.	120—125	−1	120—123
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf....	147—152	...	...
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf....	103—107	...	...
1,895,445	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	88—91	...	89¾
1,000,000	,,	Jan. 6	5	5	Do. 5 p.c. Red. Deb.	114—117	...	...
1,543,795	,,	Feb. 3	6	6	South Suburban Ord. 5 p.c....	130—135	...	131
512,825	,,	,,	5	5	Do. 5 p.c. Pref....	122—127	...	124—124
500,000	,,	,,	4	4	Do. 4 p.c. Pref....	103—108	...	...
888,587	,,	Dec. 16	5	5	Do. 5 p.c. Deb....	123—128	...	...
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	104—109	...	...
415,907	,,	Dec. 2	...	4	S. Western Gas & Water Ord.	23/—24/-	...	...
160,523	,,	Oct. 21	...	...	Do. 4½% Red. Cum. Pref.	22/—23/-	...	...
110,000	,,	Dec. 16	4	4	Do. 4% Red. Deb. ...	98—103	...	...
647,740	,,	Feb. 3	5	5	Southampt'n Ord. 5 p.c. max.	113—118	...	115¾—117½
121,275	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	98—103	...	...
350,000	,,	Feb. 3	5⅓	5⅓	Swansea 5½ p.c. Red. Pref. ...	111—116	...	...
106,000	,,	Dec. 16	6½	6½	Do. 6½ p.c. Red. Deb. ...	96—101	...	...
94,000	,,	...	...	...	Do. 3½ p.c. Red. Deb. ...	96—101	...	...
1,076,490	,,	Feb. 17	6⅔	6⅔	Tottenham and District Ord.	149—154	...	153—154½
409,835	,,	,,	5⅓	5⅓	Do. 5½ p.c. Pref....	130—135	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	122—127	...	...
371,850	,,	Dec. 2	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
369,774	,,	Feb. 3	7	7	Uxbridge, &c., 5 p.c. ...	153—158	...	156—157½
108,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	122—127	...	126½
1,340,521	,,	Feb. 3	7	7	Wandsworth Consolidated ...	158—163	...	159—161
1,371,373	,,	,,	5	5	Do. 5 p.c. Pref. ...	122—127	...	...
1,317,964	,,	Dec. 16	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
338,300	,,	,,	4	4	Do. 4 p.c. Deb. ...	104—109	...	...
499,735	,,	Feb. 17	6¾	7½	Watford and St. Albans Ord.	155—160	...	158½
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
200,000	,,	,,	5⅓	5⅓	Do. 5½ p.c. Pref. ...	133—138	...	...
200,000	,,	Dec. 2	4	4	Do. 4 p.c. Red. Deb.	100—105	...	...
100,000	,,	,,	...	3½	Do. 3½ p.c. Red. Deb.	96—101	...	...
158,400	,,	Mar. 2	5	6b	Winchester W. & G. 5 p.c. Con.	112—117	...	...

a.—The quotation is per £1 of Stock. b.—Paid £3, including 10s. on account of back dividends. * Ex div.
† Paid free of income-tax. ; For year. § Actual for three months.

Stock and Share List continued overleaf.

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STOCK AND SHARE LIST—Cont.

Stocks Officially Quoted on Provincial Exchanges

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Mar. 20.	Rise or Fall on Week.	Transactions, Lowest and Highest During the Week.
BRISTOL EXCHANGE.								
347,756	Stk.	Feb. 3	5	6	Bath Cons.	124—126	...	...
1,667,250	,,	Feb. 17	5	5	Bristol, 5 p.c. max.	119—121	...	...
120,420	,,	Dec. 16	4	4	Do. 1st 4 p.c. Deb. ...	103—105	+1	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	103—105	+1	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	125—128	...	...
274,000	,,	Feb. 17	5	5	Newport (Mon.) 5 p.c. max....	111—116	...	...
13,200	12	Mar. 16	7	8½	Pontyp'l Gas & W. 10 p.c. 'A.'	14—15*	−½	...
13,600	10	,,	5	6	Do. 7 p.c. 'B.'	11½—12*	−¼	...
40,000	10	,,	5	6	Do. 7 p.c. 'C.'	11½—12*	−¼	...
140,778	Stk.	Feb. 17	5	5	Weston-super-Mare Cons. ...	113—115	...	...
64,338	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	98—100	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	165—169	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Feb. 3	5	6½	Chester 5 p.c. Ord.	107½—112½	...	...
92,500	,,	Dec. 16	4	4	Do. 4 p.c. Pref.	100—105	...	...
32,540	,,	,,	3½	3½	Do. 3½ p.c. Deb. ...	91—96	...	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	100—105	...	...
2,167,410	,,	Feb. 17	6	6	Liverpool 5 p.c. Ord. ...	133—135	...	...
245,500	,,	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	103—108	...	...
306,083	,,	Jan. 6	4	4	Do. 4 p.c. Deb. ...	105—107	...	...
106,280	,,	Feb. 3	10	10	Preston 'A' 10 p.c. ...	202—212	...	...
189,219	,,	,,	7	7	Do. 'B' 7 p.c.	140—150	...	...
NEWCASTLE EXCHANGE.								
122,577	Stk.	Mar. 2	8	8	Blyth 5 p.c. Ord.	148—150	...	...
732,000	,,	Feb. 3	5	5	Hartlepool G. & W. Co. & New	122—124	...	...
2,061,315	,,	Feb. 3	5	5½	Newcastle & Gateshead Con.	24 9—25 3*a*	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	106½—107½	...	...
776,706	,,	Dec. 16	3½	3½	Do. 3½ p.c. Deb. ...	100½—101½	...	...
277,285	,,	Oct. 21	5	5	Do. 5 p.c. Deb. '43...	105—106	...	...
209,820	,,	Mar. 2	8½	8½	South Shields Con.	170—172	...	...
299,542	,,	Feb. 3	6	6	Sunderland 6 p.c. max. ...	129—131	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Feb. 17	7	10	Derby Con.	175—185	...	...
55,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	100—105	...	...
84,750	,,	Feb. 17	5	12	Long Eaton 'A' Ord. ...	150—160	...	...
50,000	,,	,,	4	10	Do. 'B' Ord. ...	130—140	...	...
20,000	10	June 7	5	5	Do. 5 p.c. Pref. ...	10—12	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	117—122	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Feb. 17	10	10	Great Grimsby 'A' Ord. ...	220—230	...	...
6,500	,,	,,	10	10	Do. 'B' Ord. ...	220—230	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—215	...	...
1,806,339	,,	Feb. 17	6	6	Sheffield Cons.	144—147	...	...
95,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	100½—102½	...	...

a The quotation is per £1 of Stock.

Supplementary List of Stocks and Shares not Officially Quoted

202,152	Stk.	...	...	...	Ascot Ord.	119—124	...	120
128,182	,,	...	...	...	Do. 5 p.c. Pref.	117—122	...	...
90,000	1	Nov. 4	5	5	Assd. Gas and Water Ord. ...	21/—23/-	...	...
90,000	1	,,	4½	4½	Do. 4½ p.c. Cum. Pref. ...	22/—23/-	...	22/9
17,000	Stk	Feb. 17	8	8¼	Bognor Orig. Ord. 'A' ...	162—172	...	...
62,210	,,	,,	8	8¼	Do. New Addl. 'A' ...	162—172	...	...
87,160	,,	,,	7	7¼	Do. New 7 p.c. max. ...	140—145	...	...
37,440	,,	Feb. 3	10	10¼	Cam.Univ. & Town 10 p.c.max.	210—220	...	...
125,970	,,	,,	7	7¼	Do. 7 p.c. max.	158—163	...	...
39,025	,,	,,	5 1	5¼	Do. 5 p.c. max.	108—113	...	...
65,000	,,	Mar. 2	7½	8¼	Eastbourne 'A' 5 p.c. ...	160—165	...	...
198,000	,,	,,	6	7	Do. 'B' 3½ p.c.	133—138	...	...
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	120—125	...	...
130,000	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	122—127	...	...
250,000	1	Nov. 18	...	4	Gas Consolidation Ord. ...	20 6—22 6	...	...
250,000	1	,,	...	4	Do. 4 p.c. Red. Cum. Pref.	19 6—20 6	...	+
117,251	Stk.	Sept. 23	8 3/10	8 1/10	Gosport District Cons. ...	177—182	...	...
73,350	,,	,,	5	5	Do. 5 p.c. Pref.	113—118	...	...
24,000	30	Feb. 3	8½	8½	Great Yarmouth 8½ p.c. max.	52—57	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.... ...	42—45	...	...
51,160	Stk.	Dec. 2	5½	5½	Do. 5½ p.c. Deb.... ...	123—128	...	...
152,600	,,	Mar. 2	8	8	Guildford Cons.	172—177	...	...
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	114—119	...	...
68,250	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	120—125	...	...
156,600	,,	Feb. 3	7½	7½	Hampton Court Cons. ...	167—177	...	...
81,660	10	Feb 4,'35	5	9	Leatherhead Ord.	16—17	...	...
107,960	10	Mar. 16	4	5½	Mid Kent Ord.	9½—10½*	−¼	...
230,940	Stk.	Feb. 17	10	10	Oxford & District Ord. ...	205—215	...	...
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	113—118	...	...
126,193	,,	Nov. 18	7½	7½	Peterborough Ord.	160—170	...	...
64,990	,,	Mar. 16	7½	7½	Redditch Ord.	113—118*	−3	...
166,850	,,	Feb. 17	7	9	Romford Ord.	167—172	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Mar. 16	5	5	Do. 5 p.c. Deb.	120—125*	−2	...
10,950	,,	Mar. 2	8	8	Ryde Ord.	165—170	...	...
136,191	,,	Feb. 3	5	7	Scarborough Ord.	128—138	...	...
27,825	,,	Feb. 3	8	8	Shanklin & Ventnor Cons. ...	152—162	...	...
40,643	,,	Mar. 2	7	7	Slough Ord.	147—152	...	...
221,000	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	116—121	...	...
28,872	1	Nov. 4	5½	5½	S. Midland Gas Cpn.Ltd. Ord.	20/—22/-	...	...
28,866	1	Mar. 16	4½	4½	Do. 4½ p.c. Red. Cum Pref.	19 6—21/6*	−6	...
137,730	Stk.	Feb. 17	7	7	Southgate & Dist. 7 p.c. max.	148—153	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	115—120	...	...
117,228	,,	Mar. 2	5	6	Swindon Cons.	111—116	...	...
60,425	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	122—127	...	...
50,000	1	...	...	...	Utd. Kingdom Gas Cpn. Ord.	1 3/16—1 5/16	...	21/4½—21/6
760,910	1	Nov. 18	...	2½	Do. 4½ p.c. Prefd. Ord....	20/—22/-	+3/	...
110,910	1	,,	...	2½	Do. 4½ p.c. Cum. Pref. ...	20 6—22 6	−3	...
900,000	Stk.	Mar. 16	...	3½	Do. 3½ p.c. Red. Deb. ..	98—101*	...	99
130,000	,,	Feb. 3	5	8	Wakefield Ord.	137—142	...	...
81,650	,,	,,	5	5	Do. 5 p.c. max.	101—106	...	...
82,000	,,	Feb. 3	6	6	Weymouth Ord.	106—111	...	...
370,000	,,	Feb. 3	4	6	York Cons.	107—112	...	...
90,000	,,	Dec. 16	5	5	Do. 5 p.c. Red. Deb. ...	103—108	...	...
133,640	,,	Feb. 3	6½	6½	Yorktown (Cam.) 5 p.c. Cons.	127—132	+9	...
120,000	,,	,,	5	5	Do. 5 p.c. Pref.	115—120	...	...
35,000	,,	Dec. 16	5½	5½	Do. 5½ p.c. Deb.... ...	130—135	...	...

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